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**THE CONTINENTAL SHELF IN THE LAW OF THE SEA
CONVENTIONS OF 1958 AND 1982 AND THE PRINCIPAL
OF NATURAL PROLONGATION**

Abstract

The subject of the paper is the evolution of the concept of the continental shelf in international law, shown in the context of natural prolongation of the land territory of a coastal state co-creating this concept. The starting point for the analysis are the determinations of such specialised disciplines of science as: geography, oceanography and geology, and in consequence a possibly accurate topographic description of the sea and ocean floor, determination of the most important physiographic zones and of their characteristic features. This, only formally distinguished, but treated as one whole for meritoric and structural reasons three-element sequence, formed in the order: continental shelf in geographic/physical approach - continental slope - foot of continental slope, forms a common topographic feature called the continental margin.

However, the reconstruction of the continental shelf concept in international law is not limited only to the description and characteristic of the continental margin in the horizontal plane. Appropriately to the needs of the paper, and to the extent the competence of the Author allowed, the margin is also described in the vertical dimension, i.e. going deeper into the essence of the natural factor, contained basically in the geomorphologic and geologic structure of the main physiographic provinces forming the continental margin. Such a view of the above problem allowed to obtain knowledge of motivations and of various arguments forming the essence and reach of the external limit of the continental shelf in the Geneva Convention on the continental shelf of 1958, called further in text the GC IV (1958).

However, most important was to show and prove the thesis that it was the natural factor that dictated and shaped stipulations in international law with respect to the discussed subject, and that this factor played an extremely important role in the evolution and development of the continental shelf concept during the period after CG IV (1958) was adopted. The principle, contained in the ITJ ruling on the continental shelf of the

North Sea that the continental shelf is a natural prolongation of the territory of a coastal state, the natural prolongation principle, was well substantiated by the geomorphology and geophysical characteristics of the continental margin. This principle was also of primary importance for the shaping of the concept of the continental shelf and of its external boundary in the United Nations Convention on the Law of the Sea of 1982, called below UNCLOS (1982).

1. The geographic/geological concept of the shelf

With development of science and technology and the finding of rich sources of minerals (especially oil and natural gas), in the 40ties, it became possible to mine these natural resources from areas located outside the territorial sea areas of the coastal states, in relatively shallow areas of the coastal seabed and below the subsoil. To solve arising problems, the continental shelf concept [1], known at that time to other sciences, was called on. These other sciences were expected to provide convincing proof for the construction of the legal institution of the continental shelf, substantiating the claims of the various states to these areas.

Already in the XIXth century, i.e. much before it became used in the legal language, the term "continental shelf" [2] or its synonyms operated in the terminology of such sciences as geography, oceanography, geology, geomorphology [3] in many languages: in English terminology - continental shelf [4], in French most often - plateau continental, in Russian - kontinentalnyy shelf or kontinentalnaya otmel/materikovaya otmel or platforma/plita, in German - kontinentalsockel or schelf/kruemmel, in Spanish - meseta continental [5] /plataforma continental/zocalo continental [6].

As prof. W. Góralczyk, the great Polish expert in international law and in the presently discussed problem has proved, the term "continental shelf" was first used by Hugh Robert Mill in *The Realm of Nature. An Outline of Physiography* published in 1892 in London [7].

Due to the above, this part of the paper, taking as a basis the determinations of such branches of science as: geography, oceanography, geology and to some extent geomorphology and tectonics of the sea and ocean floor, will concentrate on a topographic description of the sea and ocean bottom, on indicating the most important zones, formations or structures, and on their characteristic features.

For this reason the discussion cannot be limited to exclusively to the presentation of the continental shelf concept in the geographical and geological sense. It must reach much further because it is necessary and meritorically substantiated if premises, proof and motives really present in the nature - the topography and structure of sea and ocean bottom - are to be indicated. Especially since these arguments formed a significant basis for the legal international definition of the continental shelf adopted in the GC IV (1958), and because they were of basic importance in the juridical evolution of the concept in UNCLOS (1982) [8].

The rich literature of the subject in the mentioned above sciences, the complexity of sea and ocean bottom topography and geomorphology, make detailed discussion rather impossible - if only because of limited competence of the

author. Therefore the presented below discussion is of rather general character, and is limited to the necessary minimum (generally: to the presentation of most important zones and formations) dictated by the requirements of this paper. The typical dimensions of main elements of the sub-aqual relief are given after Heezen and Wilson [9]. However in case when supplementing or additional, divergent data are available, this is noted and names of authors are shown in the footnotes.

The continental shelf in geographical and geological sense [10]. It is the underwater prolongation of land, forming a shallow platform, which is the continuation of topographic and geological conditions on the adjoining land, however partly modified by due to marine erosion or deposition of sediments, and extending from the coast of the continents into the sea or ocean up to the geomorphologic line (bend) [11] at which it passes into the steep continental slope.

This line, i.e. the external boundary of the understood in this way continental shelf (the so-called edge), if it can only be determined without any doubt, is located at various depths, starting even from only 10 m., in the opinion of others from 50 m. and deeper [12]. The average depth of the shelf is 130 m., but sometimes it reaches 200 m [13]. It could be therefore stated that in principle the continental shelf is contained within the 0 to 200 m water depth range [14].

The width of the shelf varies between several and over 300 km (e.g. the north-east coast of USA) The average width is 75 km, according to some authors 42 Nm (78 km) [15], and range of values is enormous - from 1 Nm to over 800 Nm [16].

The slope of the shelf is up to 1:1000, the average slope being $1/8^{\circ}$ or about 3.5-3.7 m/1 Nm. In this sense the sea/oceanward boundary of the shelf (in other words - its edge) occurs when the slope starts be steeper than 1:40, and sometimes the boundary is cut by canyons. Especially shelves from the Jurassic period (e.g. the Maine Gulf) are examples of epi-continental seas which inundated large areas of the continents in effect of opening of the Atlantic.

The continental slope [17]. It is the second in order formation of the sea and ocean bottom, which begins at the edge of the shelf at a depth which in most cases does not exceed 200 m. This formation is designated by the bend of the shelf, and reaches to the depth of 2-3 km [18] (in most cases 200-500 m) [19], i.e. to the beginning of the pre-continental uprising.

The slope of the continental slope is 4-13 $^{\circ}$, but the most steep have a slope of 27 $^{\circ}$ (e.g. of Australia), reaching even 45 $^{\circ}$. In cross-section the slope is flat or slightly sinusoidal, it also can contain a series of steep slopes. The range of its width is very large - from several to 150 km (e.g. the north-east coast of USA), and the average width given by various authors also strongly varies - from 15 to 30 and even 48 km [20].

Continental slopes vary in geological and genetic structure. Some of them are fault surfaces, i.e. they are edges of drifting from each other continents, others are built from terragenic sediments, and still others are kind of dams (fault blocks, corral reefs [21], volcanic chimneys), behind which sediments are accumulated.

The precontinental uprising in other words the continental foot is the third in order principal subaqual zone, physiographic province - which corresponds to

piedmont alluvial flatlands - occurring seaward of the continental slope at a depth of several thousand metres (normally 1500 to 5000 m) [22]. The width of the uprising is between several to 600 km from the foot of the continental slope, and the slope of the uprising varies (typically between 1:1000 and 1:700, but it can be 1:2500 and also 1:50). It is interesting to note that seismic investigations show that the uprising is built of cones of sediments of up to 6 km thickness.

Deep ocean floor. Among its elements, the following are most often mentioned [23]: a) oceanic uplands - areas of spreading [24], mid-ocean ridges rising above the ocean bottom at 4 km depth, which are the youngest parts of the ocean floor, with thin or no sediment cover [25]; b) abyssal plains and hills; c) oceanic troughs - the deepest parts of the oceans running along about half length of continental margins, and some of them along the continental edge (e.g. of South America in the hinterland of which the Andes are located; d) underwater mountains; e) guyots - flattened underwater mountains; f) aseismic ridges, i.e. linear volcanic forms.

The three above mentioned zones - underwater physiographic provinces: continental shelf, continental slope and continental foot are thought to reach the abyssal plain [26]. They form a sequence, a common topographic feature called the continental margin [27], which is one of the two main features of the ocean bottom according to most authors, the second feature being the deep ocean floor [28]. Some authors distinguish three [29], adding the main systems of ocean ridges [30].

Without questioning the above remarks, it should be remarked in conclusion of this part of the paper that there is a good reason for the statement that while the territory of the state in strict sense is terra firma - land and islands - i.e. something which has already been objectively and precisely defined, the continental shelf depends in each individual case on many factors, such as e.g. the geologic and morphologic structure of the sea floor, geographic position, distance, water depth, etc [31]. Therefore, at the beginning the concept of "continental shelf" in international law rested only on a part of the topographic characteristic (on the continental shelf in geographic/physical sense [32], described also as "continental border-land" [33], i.e. a part of the bottom around the continent sloping slightly to the depth of most often 200 m or 100 fathoms, though sometimes reaching more than 100 fathoms or less than 65 fathoms [34]. However, with movement forward and to larger depth along the profile, the concept should be modified. This problem is discussed below.

2. The juridical concept of the continental shelf and the natural prolongation principle in the judicature and practice of states

The juridical concept of the continental shelf, especially its reconstruction, absolutely must take into account - at least in general terms - the natural factor contained especially in the geomorphologic and geologic structure of the main physiographic provinces forming the continental margin [35].

At first view this may seem completely unnecessary, but in fact it is the opposite, since the above thesis is strongly supported by the geomorphology and predominant geophysical characteristics of the continental margin. These charac-

teristics were of basic importance for the formation of the concept of the continental shelf in international law, especially in UNCLOS (1982).

This was not the first time when natural factors dictated and shaped juridical international stipulations, being of a primary and basic character with respect to the secondary phase which consisted in a given international law. Jurists and diplomats with time and need discovered them, seeking rational motivation and convincing argument and proof, substantiating their legal standpoint with respect to designed stipulations or solutions in the international law [36]. This phenomenon is certainly especially clearly visible in the example given by the development of the concept of continental shelf in international law, and especially with respect to the evolution of that concept.

The presented in point 1 topographic description of physiographic provinces is certainly important, and cannot be disregarded, since it played a positive role at a certain stage. Especially if we compare the first physiographic province and the continental shelf concept in GC IV of 1958, then it will become quite clear that this relationship is evident and decidedly not accidental.

However, though the topographic description is important, it is also insufficient because it characterises the undersea provinces in principle in the horizontal plane only. Their description in the vertical is also required, so that the structural relationships expressed by the internal build of the continent and adjacent continental margin may become clarified.

An insight into the geomorphologic and geologic structure of the sea and ocean bottom, at least in such a scope as is dictated by the needs of the paper and the competence and abilities of the author. In effect: a view of the continental crust and to some extent of the oceanic crust for two basic formal reasons: 1) the concept of continental shelf in international law - especially the natural prolongation principle which creates this concept; 2) establishing the boundaries of the shelf, or more strictly speaking of the well-known co-creating principle, which finally results in a just solution.

This part, while taking into account determinations made in point 1, shall focus mainly on the above mentioned principle of natural prolongation, proven by geomorphologic and geologic arguments. The problem of reach - of the external boundary of the internationally legalised continental shelf - is not really discussed, since the fundamental prolongation principle will influence the reach of the shelf. The reach (width) of the shelf is a consequence of the principle, i.e. it is secondary - a resultant value.

It should be stated in this place that the use of the adjective continental with respect to the discussed physiographic provinces of the continental margin is not accidental. Though the adjective itself still does not explain much at this place, it certainly suggests that the structural relationship of the earth's crust in the horizontal and vertical plane between the continent (land territory of a coastal state) and the undersea provinces, expressed by the phenomenon of natural prolongation of land, really exists.

Independently of the proposed theories, - e.g. the lithosphere plates [37], or the continental drift theory (epeirophoresis) [38], according to which in the past all continents one large continent (Pangea) [39], which broke up and inundated by seas and oceans (continental drift) and this is considered the explanation for "the evident fitting of continents" [40] their "similarity" or "adherence" [41] - the geomorphologic relationship between the continental crust [42] and the Earths crust (lithosphere) [43], i.e. the continent - land territory of coastal state [44], has been proven experimentally. This confirms the principle of natural prolongation of that territory and creates its juridical concept in international law.

The continental crust within the 3 undersea provinces of the continental margin - the continental shelf in geographical and geological sense, the slope and partly the continental uprising [45] - is of the type of the Earths crust [46] which is typical for continents (continental blocks) [47], and at the same time it is a prolongation of this type of crust.

From the structural point of view, in the continental crust the following layers can be distinguished in the downward direction: a) deposit layer (of up to over a dozen km thickness, average several km), b) granite layer (of up to 30 km thickness, average about a dozen km), c) basalt layer (with thickness from several to about 40 km, average about 20 km, sometimes built of gabbro or granulite).

The next in order sub-oceanic (sub-continental) crust, though its geomorphologic structure and thickness of the layers varies is also a continuation of the continent. This also is a certain type of the Earths crust - transient between the continental crust and the oceanic crust, in principle characteristic for the pre-continental uprising [48]. In very general terms, it is characterised by the presence of the above mentioned layers but often with a very large thickness of the deposit layer [49] appearing in the form of a cone thinning oceanwards as a result of accumulation of sediments by suspension, deep sea currents and by undersea landslides [50], a relatively thin and in places non-continuous (broken up) granite layer. The sub-oceanic crust is characteristic among others to oceanic troughs, and also to some oceanic shelves.

The oceanic crust, located farthest seaward, which is characteristic for a part of the continental uprising but basically for the oceanic bottom and substratum outside the uprising (abyssal plane), also is a type of the Earths crust, which to some extent justifies the prolongation of the continent and the concept of adherence (contiguity) [51]. In this area the very important phenomenon of multiple thinning of all the layers (deposit, transient, basalt layers) in comparison with the layers in the earlier discussed belts may be observed. Sometimes the transient layer does not occur at all. The most important for our discussion deposit layer - built mainly of sedimentary rocks and of sediments in the process of lithogenesis [52] - has a thickness varying from several hundred metres to even several kilometres, but on average its thickness is several hundred metres.

The above presentation - though very general and certainly not reflecting all the subtleties of the very complex problem of geomorphologic and geologic structure and of topographical relationships in plane and vertical - leads to the obvious conclusion that the Earths crust - continental-subcontinental/suboceanic-oceanic - expresses in consequence the principle of natural prolongation of the territory of a

coastal state and the essence of contiguity and land prolongation. Most important, the so-called first (deposit) layer, which is most important in the context of this principle, very well describes the external boundary of the continental shelf in international law.

This is because with moving seawards from the continent along the profiles of the physiographic provinces this first layer shows a distinct thickness reduction trend, and finally of disappearing, in most general terms reminiscent of a gradually thinning wedge [53]. This layer, through the continental shelf, slope, continental/pre-continental uprising, up to the abyssal plain, transfers from unconsolidated terrigenous sediments of various grain size, through muds and clays - sometimes lithified and sheared - to muds mainly from suspension currents [54].

In the light of the above it becomes clear why in the case of the continental shelf of the North Sea the ITJ stated that the continental shelf of a coastal state "...constitutes a natural prolongation of its... territory" and that this underwater area is a part of the states territory over which it has governance in that sense, that though the area is covered by water it is a "...prolongation or continuation of that territory, an extension of it under the sea" [55].

These statements of the Tribunal - as is stressed by experts - cannot be interpreted as if the ITJ recognised the continental shelf as a part of the territory of a state in factual and legal sense with identical legal status as the territory of the state [56]. The main objective was to stress the geomorphological unity between the land and underwater areas - which logically and semantically is contained in the term "natural prolongation". However, this fact still does not result in an identical scope of political governance.

The intention of the ITJ was to show that the basis and strength of the rights of a coastal state on the continental shelf results from the principle of realising sovereignty over the territory of the state [57]. However, this by no means results in a straightforward transmission and identity of these rights, which, as O'Connell rightly pointed out, is with good reason contained in the distinction: sovereignty - land territory + territorial sea; sovereign rights in given scope - continental shelf. This also shows that the continental shelf is an object of specific functional competence of the coastal state, similarly as the contiguous zone of the sea and the exclusive economical zone [58].

The ITJ ruling of 20th February 1969 on the continental shelf of the North Sea was an important step in the development of this institution, and the Tribunal contained in the ruling many significant arguments on the continental shelf in general, precisising, explaining or supplementing earlier regulations of the GC IV (1958). At the same time the ruling showed that the Tribunal sees the need for modifying the existing normative outlook on the question of the external boundary of the continental shelf in international law.

The most important of them is the concept, the principle, of natural prolongation [59], and the related with it rule of primacy of land over the sea.

In its interpretation of the first articles (1-3) of GC IV (1958) [60], which it named the most fundamental of all legal regulations concerning the continental

shelf [61], the ITJ pointed out that the most important fact, co-creating at the same time the element of the doctrine of justice, is this [62] that from the geological and geomorphologic point of view the continental shelf is a natural extension seawards of the land territory of coastal states, the only difference is that it is covered by water. These states exercise exclusive rights with respect to exploration and exploitation of natural resources of the sea bottom and of soil below the bottom. These rights are vested *ipso facto* and *ab initio* on the strength of the sovereignty of a state over its land territory.

When stating that the continental shelf and land territory of a state are a unity - a physical fact - the ITJ explained that the concept of the continental shelf appeared as a result of recognising the "physical fact" and the relationship between the fact and the law, without which this concept would have never appeared, becoming an important element for the adoption of the legal system of the continental shelf [63].

Discussing further the thesis on the natural relationship of undersea extension of a coastal states land, the ITJ rejected the contiguity - nearness - criterion as a condition concerning one or other area of the continental shelf seabed in the GC IV (1958) sense. In result, by accepting that the nearness of a seabed area to the coast is not in itself a sufficient basis for the derivation of rights to these areas by coastal states, the ITJ also pronounced itself against the idea that the concept of contiguity with the coast can be treated as a fundamental and unchangeable rule [64].

In the opinion of the ITJ, the most important in determining the affiliation (status) of a seabed area (of continental shelf) to a coastal state should be the principle of natural prolongation of land territory. The ITJ also explained that in accordance with international law the basis and strength of the rights of a coastal state on the continental shelf results mainly from the fact that the seabed should be actually considered as a part of the territory over which a coastal state is already executing its powers, i.e. in the sense that though the area is covered by water, it is a continuation or prolongation of the land territory of the state reaching into the sea [65].

The ITJ discussed also the meaning of various terms used in literature, regulations of states and in international conventions indicating contiguity (nearness) [66] of the seabed/soil below seabed covered by the continental shelf principle. Among others, such terms as "near/close" to "the shores", "neighbouring", contiguous etc. were discussed. According to the very proper opinion of the ITJ, such terms, though they do to some extent express the general idea, due to their imprecision allowing for many interpretations, should be rejected.

Giving special attention to the term used in conventions - contiguous to the coast - the ITJ stated that it is impossible to prove that every point on the continental shelf, lying for example at a distance of 100 Nm or less from the shore, can be considered as contiguous to the coast in the normal sense of the word contiguous [67]. As the ITJ observed, even more arguments for such a thesis could be found in the cases when the continental shelf in physical/geological sense begins to connect with the abyssal oceanic bed [68].

Confronting the contiguity criterion contained in GC IV (1958) and the natural prolongation principle, the ITJ found the criterion improper, taking into account

that it is a significant component for determining the external boundary of the international juridical continental shelf. Giving precedence to the above principle, ITJ in a way met the practice of the states, but also took into account the natural factors, the geomorphologic and geologic structure of the seabed in vertical, reaching far outside the classical topographic description (geographical/physical shelf), because basing on that principle it was possible to come to the conclusion that areas of the seabed lying at a distance of 200 Nm or more from the coast/baseline of the territorial seas of states [69] are a natural prolongation of their territories.

In this way, while justifying the doctrine of the continental shelf, the ITJ actually reconstructed concepts which appeared before this doctrine came to life, and agreed with these states, which basing on unilateral acts claimed their right to natural resources on and below the seabed located outside the external boundary of their territorial sea, in fact justifying these acts by the principle of natural prolongation, later reconstructed by the ITJ.

Already the first act, the well known proclamation of the US President H. Truman of 28 IX 1945 among many important decisions qualified the continental shelf as an extension of the organically connected with it continental massive of the coastal state, and the natural resources of the shelf as a prolongation of the resources located within the territory of the state [70].

Similarly, acts of other states following the US example, especially of Latin American states [71], referred to the principle of a natural relationship or dependence between the continental shelf and their respective land territories, justifying by that their unilateral claims to the natural resources of the continental shelf (most often the 200 Nm zone of seabed), and sometimes also to the waters covering the shelf [72]. For example, the Argentinian decree of 11 X 1946 on the continental shelf contained a stipulation in accordance with which the underwater platform, called also the continental shelf, closely connected with land both in morphological and geological sense [73].

The Peruvian presidential decree No. 781 of 1 VIII 1947 (similarly the oil law of 1952 and the mining law of 1971) established that the continental shelf represents the underwater continent - therefore a morphological whole - located at a distance of 200 Nm from the land/island territory of Peru [74]. Similarly, the Brazilian decree of 1950 stated that the seabed adjacent to the continent forms together with the land to which it is contiguous an inseparable whole [75].

A primary significance is given to this factor - the principle of natural prolongation - was given also by the Inter-American Conference in Dominican Republic (15-28 III 1956), which pointed out that from the geomorphologic point of view the continental shelf is an integral part of the continental structure [76].

To summarise, one should agree with the view that principle of natural prolongation formulated by the ITJ in its ruling of 20 II 1969, and confirmed by consecutive rulings of international tribunals on the continental shelf, was in fact to some extent reconstructed separately from the GC IV (1958), as an element of the general international juridical doctrine of the continental shelf, which according to the

opinion of the ITJ was shaped and functions as one of the institutions of international case-law, independently of the negotiation and adoption of GC IV (1958) [77].

However, it also seems that overcoming of the contiguity criterion, written into the CG IV (1958), and in consequence the replacing of it by the natural prolongation principle, was significantly facilitated by the dynamic criterion of technical capacity to exploit by the 200 m depth contour adopted by the convention as proper for determining the external boundary of the juridical continental shelf. In the end, in most general terms, this criterion made the contiguity formula inadequate and impractical, therefore it had to be left aside [78].

Legislative and treaty practice of many states, both before and after the CG IV (1958) was adopted, motivated to a large extent by the geomorphologic/geologic characteristics of the seabed discovered with the progress of science and technology, extended far outside the traditional concept of the continental shelf in the geographic/physical sense, and was in fact based on the principle of natural prolongation. This indicated that the criteria for determining the external boundary of the continental shelf given in CG IV (1958) should be modified, and in effect the geographic concept of the shelf concept should be replaced. Therefore new criteria for determining the external boundary of the juridical continental shelf were needed.

Consequently in its ruling of 30 VI 1977 concerning the delimitation of the continental shelf in the La Manche Channel (France - United Kingdom of Great Britain and Northern Ireland), the Tribunal stated again (§ 100-101) that the principle of natural prolongation is a fundamental principle and the main source of the continental shelf doctrine [79].

The above rulings on delimitation of the continental shelf give strong proof that at the basis of the juridical concept of the continental shelf lies mainly the geophysical/geomorphologic factor, expressed by the principle of natural prolongation of land territory of a coastal state [80]. UNCLOS (1982) in its art. 76 § 1 [81] only confirmed the correctness of this thesis expressed by international judgements, and formulated the concept of the continental shelf in international law [82].

References

- [1] It should be noted that to some extent the formulated in the XXth century doctrine of the continental shelf called on the 1858 Cornwall Submarine Mines Act, which treated fossils and minerals located on the bottom of the high seas adjoining to the land "as part of the soil and territorial possessions of the Crown". F.A. Vallat, *The Continental Shelf* [in] *British Yearbook of International Law* (BYIL) 1946, p. 333-334.
- [2] Besides this, the term submarine areas was proposed calling on the British-Venezuelan Treaty of 1942; see M.W. Mouton, *The Continental Shelf*, the Hague 1952, p. 12; R. Young, *The legal status of submarine areas beneath the high seas*, "American Journal of International Law" (AJIL) vol. 45, 1951, p. 227.

- [3] This lineage was pointed out by: *Background material on the juridical aspects of the continental shelf and marine waters* (Chapter III of the Agenda), OAS. Ciudad Trujillo, Dominican Republic 1956 p. 1.
- [4] See J. Stanisławski, *The Great English-Polish Dictionary*, with supplement, Warszawa 1977 (A-N), p. 162, (O-Z), p. 249-250, (in Polish).
- [5] Used by the Argentinian José L. Suárez in relation with the proposition presented on 6th April 1925 to the League of Nations. Extensive discussion in: T. Spivakova *Pravo i prirodnyye resursy pribrennykh zon*, Moscow 1978, p. 101-102.
- [6] More in: W. Góralczyk, *The continental shelf. A study in international law*, Warszawa 1957, p. 36-37, (in Polish). See also list of acts using the term "continental shelf" or similar in the period 1916-1952. T.A. Garaicoa, *El Mar Territorial y El Mar Patrimonial*, Universidad de Guayaquil 1973, p.92-94.
- [7] W. Góralczyk, *L'évolution du concept de plateau continental* [in:] *Iranian Review of International Relations* 1978. *The New Law of the Sea* (IRIR 1978), p. 121. An earlier date (1887) is given by P.R.R. Gardiner *Reasons and methods for fixing the outer limit of the legal continental shelf beyond 200 nautical miles* [in:] *ibid.*, p. 146.
- [8] See M.L. Jewett, *The evolution of the legal regime of the continental shelf* [in:] *Canadian Yearbook of International Law* (CYIL) vol. 22, 1984, p. 153 and next.
- [9] More in: C. Ollier, *Tectonics and forms of landscape*, (translated from English by J. Gawlik), Warszawa 1987, p. 286-287, (in Polish).
- [10] More in: *ibid.*, p. 284-285; K.K. Turekian *The Oceans*, (translated from English by A. Majewski, A. Trzosińska), Warszawa 1979, p. 32 (in Polish); A.L. Shalowitz, *Shore and sea boundaries*, vol. 1, Washington 1962, p. 182-186. This is a wider concept of the shelf than geographical, since - as G.N. Cecatto has remarked, it is involved not only with bends of the shelfs edge, but it also takes into consideration structural relationships: the continental massif - sea bottom. The same: *L'évolution Juridique de la Doctrine du Plateau Continental*, Paris 1955, p. 20-24, 27-29; see also: *Mezhdunarodnyy Rayon Dna mirowogo Okeana* (ed. L.L.L. Lyubimov), Moscow 1980, p. 34-35. The above motive is clearly raised in the geological definition of the shelf of J.A. Roach, R.W. Smith, *Excessive maritime claims* [in:] *International Law Studies*, vol. 66, Newport 1994, p. 121, where they point out that its sense is different from the juridical sense in GC IV (1958).
- [11] If several bends are present the shelf is established as indicated by F. Shepard. See entry "kontinentalnyy shelf" [in:] *The structure of continents and ocean - terminological dictionary*, Eds. Y.A. Kosygin, V.A. Kuyndyshev, V.A. Solovev, Moscow 1979, p. 359, (in Russian).
- [12] More in: V.J. Shestopalov, *The Persian Gulf: problem of the continental shelf*, Moscow 1982, p. 3, (in Russian).
- [13] According to another source - even to 500 m and more, and the 200 m depth is considered as the mean depth. More in: K.K. Turekian *Oceans...*, p. 32 and

- next, (in Russian); K. Łomniewski, *Physical Oceanography*, Warszawa 1970, p. 98-103, (in Polish).
- [14] See G. Gidel, *La plataforma continental ante el derecho*, Universidad de Valladolid 1951, p. 14-15.
- [15] V.Y. Shestopalov, *Persian...*, p. 3, (in Russian); M.W. Mouton, *The continental...*, p. 22.
- [16] But in the case of the African shelf (Indian Ocean) the width is only 1-20 Nm, and in case of the Asian shelf it is only 1-4 Nm; More in: G.S. Ananov, O.K. Leontev, *Geomorfologiya materikov i okeanov*, Moscow 1987, p. 213-215, (in Russian).
- [17] Together with the shelf it forms the continental terrace. See *Memorandum Préparé par le Secrétariat de L'Organisation des Nations Unies pour L'Education, La Science et la Culture* [in:] I.C.J. Pleadings, *Continental Shelf (Tunisia - Libyan Arab Jamahiriya)*, vol. I, p. 440 and next.
- [18] More in: C. Ollier, *Tectonics...*, p. 288, (in Polish).
- [19] See the diagram of sea nad ocean bottom. *Mezhdunarodnoye morskoye pravo, Spravochnik*, ed. G.S. Gorshkov, Moscow 1985, (in Russian).
- [20] Ibidem.
- [21] More in: O.K. Leontev, L.G. Nikiforov, G.A. Safyanov, *Geomorphology of sea coasts*, (translated from Russian by S. Musielak and S. Rudowski), Warszawa 1982, p. 273 and next, (in Polish).
- [22] More in: C. Ollier, *Tectonics...*, p. 288-289, (in Polish). Also the term foot of continental slope is used, and L. M. Alexander, basing on geological investigations states that in most cases it is located at the (average) depth of 2500 m; however there exist departures from that principle (e.g. along the west coast of South America the slope reaches 8000 m). Therefore the largest difficulty lies in the precise determination of the point which forms the boundary between the slope and the uprising, i.e. the position of the foot. The same author, *Alternative methods for delimiting the outer boundary of the continental shelf* [in:] *United States Department of State (USDS)* 1970, p. 18 and *The seabed and the ocean floor. Future regimes: a survey of proposals* [in:] *New directions in the law of the sea, collected papers* vol. III, London 1973 (NDLS CP), p. 127-128; see K.O. Emery, *Geological aspects of sea-floor sovereignty* [in:] *Law of the sea. Offshore boundaries and zones* (ed. L.M. Alexander), Ohio State University 1967 (LS OBZ), p. 150-151.
- [23] More in: C. Ollier, *Tectonics...*, p. 283 and next, (in Polish).
- [24] More about this concept in: S.A. Kurenkov, A.S. Perfilov, *Spreading v okeanicheskikh i kontinentalnykh strukturakh* [in:] *Aktualnyye problemy tektoniki okeanov i kontinentov* (ed. P.P. Timofeyev) Moscow 1987, p. 153 and next, (in Russian).
- [25] The experimentally observed rule concerning the ocean bottom in general must be stressed: the undoubtedly thin layer of deposits resting on the bottom of oceans. The thickness of this so-called first layer directly below the sea floor is very variable, ranging within several hundred metres, and someti-

mes reaching over 2000 m. For example, on the Atlantic it is only 800 m, on the Pacific it is even thinner. More from the well-known American Program Mohole, realised within the framework of the Lamont Geological Observatory of the Columbia University in New York in the excellent work of two outstanding scientists: D.B. Ericson and G. Wollin, *Ocean depths and the past of the Earth*, (Polish translation H. Sylwestrzak and E. Woźny), Warszawa 1968, p. 383 and next, (in Polish).

- [26] See entry "kontynentalnaya okraina" [in:] *Structure...*, p.356-357, (in Polish).
- [27] The term "continental margin" is used in the *Memorandum...* p. 441 and next; a geomorphological description together with maps of continental margins of oceans and diagrams. G.S. Anan'ev, O.K. Leontev *Geomorphology...*, p. 185-259, (in Russian); S.R. Casey Jr., *Precept for benthic exploration and exploitation*, Dallas 1968, p. 37-38; R. Cullen, *Federalism in action. The Australian and Canadian offshore disputes*, Monash University 1990, p. 21; J.R. Clark, *Coastal ecosystem management*, New York, London, Sydney, Toronto 1977, p. 21. See A. Straburzyński, *Exclusive economic zone and the continental shelf*, "Przegląd Stosunków Międzynarodowych" (PSM) 1982 No. 1-3, p. 152, (in Polish); A. Guilcher, *The seabed and the ocean floor geo-physical characteristics* NDLS CP, p. 109-110.
- [28] More in: C. Ollier, *Tectonics...*, p. 283 and next, (in Polish).
- [29] K. K. Turekian, *Oceans...*, p. 32 and 35, (in Polish).
- [30] More in: A. J. Smith, *The scale of EEZs with particular reference to areas of US and UJ jurisdiction: problems associated with exploitation and also protection of EEZ resources* [in:] *Advances in Underwater Technology, Ocean Science and Offshore Engineering*, vol. 8, *Conference: London 1986* (AUT), p. 106-109; J. Polvêche, *Les Arguments Géologiques et l'Extension de la Souveraineté Nationale sur le Domaine Marin* [in:] *Les Fonds de Mers. Aspects juridiques, biologiques et géologiques* (C.A. Colliard, R.D. Dupuy, J. Polvêche, R. Vassière), Paris 1971 (LFM), p. 102 and next; J.R.V. Prescott, *Boundaries and Frontiers*, London 1978, p. 149 and next.
- [31] More in: Diss. Op. De Castro. I.C.J. *Aegean sea continental shelf case (Greece v. Turkey)*. Judgement of 19 XII 1978, p. 65.
- [32] This is pointed out by G. Apollis, *L'Emprise Maritime de L'Etat Cotier*, Paris 1981, p. 55-56.
- [33] See: S.W. Boggs, *Delimitation of seaward areas under national jurisdiction*, *AJIL*, vol. 45, 1951, p. 245.
- [34] This formula is given in the *Memorandum...*, p. 441 and next; also with reference to Wiseman and Ovey, M.W. Mouton, *The continental shelf* [in:] *Recueil des Cours de L'Académie de Droit International* (RCADI) 1954 (I), p. 348; see literature and the different depth contours given for different shelves, B.B.L. Auguste, *The continental shelf: the practice and policy in the Latin American States with special reference to Chile, Ecuador and Peru*, Geneva 1960, p. 29-31.
- [35] It should be mentioned that besides the continental margin which was discovered somewhat later, to some extent the institution of the continental shelf was

created by the sedentary fisheries concept with a number of related acts developed in the period 1800-1900. As early as 1910 Portugal prohibited the use of trawl nets in seabed areas with depths smaller than 100 fathoms (182.9 m), and 6 years later Russia substantiated its claim for the islands on the Siberian continental shelf by the fact that they lie on the extension of the continental Siberian platform - a substitute of the natural prolongation principle. This normative thread is strongly accentuated by B.B.L. Auguste: *ibid.*, p. 13-15; J.C. Lupianacci, *La Plataforma Continental Como Instituto del Derecho del Mar*, Serie de Publicaciones Especiales No. 61, Universidad de Chile 1984, p. 3; see also R. Bierzanek, *High sea from the point of view of international law*, Warszawa 1960, p. 87 and next, (in Polish).

- [36] It is worth mentioning that as early as 1938 the French section of ILA and the ILA during its 44th session in Copenhagen (1950) stressed that the continental shelf is a continuation of the structure of a continent in geomorphologic sense. J. Andrassy, *Epikontinentalnij pojas*, Zagreb 1951, p. 55-56; J.L. De Azcárraga, *La Plataforma Submarina y El Derecho Internacional*, Madrid 1952, p. 145 and next.
- [37] This theory, together with a graph and the theories of Earths crust accretion, expansion and contraction, is more widely discussed in: W. Jaroszewski, L. Marks, A. Radomski, *Dictionary of dynamic geology*, Warszawa 1985, p. 9, 263-264, (in Polish).
- [38] *Ibidem*, p. 45.
- [39] Graphical description of disintegration of Pangea and comments. K.K. Turekian, *Oceans...*, p. 162-167.
- [40] *Ibidem*, p. 155.
- [41]. According to C. Ollier, it seems that the first to describe the phenomenon of adherence of continental coasts was Francis Bacon (1620). A list of other authors and a careful analysis of adherence in context of continental drift and ocean bottom spreading; more in: C. Ollier, *Tectonics...*, p. 23 and next, (in Polish).
- [42] More see also Mohorovičić fault in: W. Jaroszewski, L. Marks, A. Radomski, *Dictionary...*, p. 156 and 226, (in Polish).
- [43] See also the excellent set of papers from the international IUMC symposium in Ottawa in 1965. *Okrainy kontinentov i ostrowyye dugi*. Ed. U. Ch. Pu. Translated from English by H.A. Titovoy, Moscow 1970, p. 11 and next, (in Russian).
- [44] More in: W. Jaroszewski, L. Marks, A. Radomski, *Dictionary...*, p. 226-227; M. Klimaszewski, *Geomorphology*, Warszawa 1978, p. 64 and next, (in Polish).
- [45] See graph in: W. Jaroszewski, L. Marks, A. Radomski, *Dictionary...*, p. 225, (in Polish).
- [46] Vertical cross-section of Earths crust showing the layers and discontinuities - Conrad, Moho, among others for oceans [in]: *ibid.*, p. 226.
- [47] More under entry [in:] *ibid.*, p. 20.

- [48] More under entry [in:] *ibid.*, p. 189 and 226.
- [49] On these sediments and their layers - more in: M. Ksikiewicz, *Dynamic geology*, Warszawa 1968, p. 314-315 and 432 and next, (in Polish).
- [50] Complex analysis of the problem in relation to the type of slope in: O. K. Leontev *Geomorphology of coasts and sea bottom*, Moscow 1955, p. 326-327, 332-333, (in Russian).
- [51] More in: W. Jaroszewski, L. Marks, A. Radomski, *Dictionary...*, p. 226, (in Polish).
- [52] See entry in: *ibid.*, p. 130.
- [53] However, there are exceptions - especially interesting is the case of the Gulf of Bengal, which has a very narrow shelf and continental slope, while because the Ganges and Brahmaputra rivers discharge annually over 2 billion tonnes of terragenic sediments into the Gulf the bottom outside these provinces (uprising) has the largest in the world uprising cut by numerous constantly changing troughs. This is why Burma, which has a very wide uprising has been supporting so strongly the principle of natural prolongation with respect to the shelf, stating that this is one of the basic principles of the law of the sea, it is the source of sovereign rights over the shelf and the measure of the reach of juridical shelf, and that the text of this principle should be taken into account when establishing boundaries on the shelf between neighbouring states, lack of which solution is a serious omission of art. 6 of GC IV (1958). More in graphic diagram and comment: G.S. Ananev, O. K. Leontev, *Geomorphology...*, p. 216-217, (in Russian); statement of U Kyaw Min (Burma) [in:] *Official records of the Third United Nations Conference on the Law of the Sea* (OR III UNCLOS), vol. II, New York 1975, p. 155.
- [54] More in: C. Ollier, *Tectonics...*, p. 289, (in Polish).
- [55] See § § 19, 43, 51, 58, 85 North Sea Continental Shelf Cases (FRG - Fenmark; FRG - The Netherlands) cited further - Judgement 20 II 1969 [in:] *ICJ Reports 1969*, p. 22 and next; more in: K. Highet, *Whatever became of natural prolongation* [in:] *Rights to oceanic resources* (Ed. D.G. Dallmeyer, L. De Vorsev Jr.), Dordrecht, Boston, London 1989 (ROR), p. 87 and next.
- [56] An identical point of view is presented by O'Connell, who additionally refers to the standpoint of the French Conseil d'Etat, in accordance with which the continental shelf is not a part of the territory of France, concluding that a fortiori the continental shelf is extra-territorial. More in: *Argument of prof. O'Connell. ICJ Pleadings. Aegean Sea Continental Shelf Case (Greece v. Turkey)*, p. 139 and 441.
- [57] More in: § 9 Diss. Op. De Castro..., p. 65 and next.
- [58] *Argument of prof. O'Connell...*, p. 441; the functional reach of rights is accentuated by A. Straburzyński, *Exclusive...*, p. 146, (in Polish); see F.V.W. Penick, *The legal character of the right to explore and exploit the natural resources of the continental shelf* [in:] "San Diego Law Review" (SDLR), vol. 22 1985, p. 765 and next.
- [59] It expresses physical/geographical facts and appears in two meanings. In the wide sense it simply means that the land surface does not end at the seas edge,

while in the more narrow specific sense it means that the structure of the continental mass is significantly the same in spite of covering by water. More in: D.P. O'Connell, *The international law of the sea*, vol. I (ed. I.A. Shearer) Oxford 1982, p. 446.

- [60] Text in: K. Kocot, K. Wolfke, *Selected documents for learning international law*, Wrocław-Warszawa 1976, p. 262-263, (in Polish); Judge Tanaka commented that they "...constitute the fundamental concept of the continental shelf..." Identically *Argument of prof. O'Connell...*, p. 97.
- [61] In its ruling of 20th February 1969, the ITJ several times expressed its opinion that the three first articles reflect the case-law in this respect, and that the most important among them is art. 2, which sanctifies the natural prolongation formula. See § 22, 63 in Judgement 20 II 1969, p. 23 and next; also in *Argument of prof. O'Connell...*, p. 96-97.
- [62] The most significant fragment of the thesis is "...namely that the rights of the coastal State in respect of the area of continental shelf that constitutes a natural prolongation of its land territory into and under the sea exist ipso facto and ab initio, by virtue of its sovereignty over the land, and as an extension of it in an exercise of sovereign rights for the purpose of exploring the seabed and exploiting its natural resources..." § 19 Judgement 20 II 1969, p. 22.
- [63] See § 43 Judgement 20 II 1969, p. 31.
- [64] See § 42 Judgement 20 II 1969, p. 30.
- [65] See § 43 Judgement 20 II 1969, p. 31.
- [66] Among the most often used terms, the ITJ mentioned: "near", "close to its shores", "off its coast", "opposite", "in front of the coast", "in the vicinity of", "neighbouring the coast", "adjacent to", "contiguous" etc. See § 41 Judgement 20 II 1969, p. 30.
- [67] The problem of configuration of the continental shelf was also raised, showing that the so-called Norwegian Trough, lying at a distance of 80-100 km off the Norwegian coast, excludes in physical sense considering it as a contiguous area. More in: § 45 Judgement 20 II 1969, p. 32; differently prof. François: contiguity "...does not preclude submerged areas separated from the coast by a narrow channel of more than 200 metres depth from being considered in certain circumstances as - contiguous to the coast". CIL (Commission on International Law) presents such cases as "equitable modification of the rule - adjacent". *The continental shelf doctrine*. Thesis by L.F.E. Goldie (typewritten text at the Columbia University in the C.N.Y. 1961), p. 158 and 191, (note 32).
- [68] More in: § 41 Judgement 20 II 1969, p. 30.
- [69] On this line and its determination in CIL and UNCLOS (1958): T. Gihl, *The baseline of the territorial sea*, Stockholm 1967, p. 128 and next; A.G. Robles, *La Anchura del Mar Territorial*, Mexico 1966, p. 55 and next; E. Anderson, *The importance of geographical scale in considering offshore boundary problems*, MBOR - Maritime Boundaries and Ocean Resources, Ed. G. Blake, London-Sydney 1987, p. 52 and next; J.R.V. Prescott, *Straight and archipelagic baselines* [in:] *ibid.*, p. 38 and next; V.M. Rangel, *Natureza*

Juridica e Delimitação do Mar Territorial, São Paulo 1970, p. 128 and next; T. Scovozzi, *La Linea di Base Normale LBMT - La Linea di Base del Mare Territoriale, a Cura di Tullio Scovazzi*, Milan 1986, p. 35 and next; systems of straight baselines of several dozen states including graphs for *int. alia* Denmark, Ecuador, Ireland, Island, Thailand, Cambodia, Sweden, Finland, Canada (Vancouver Baffin Islands, Queen Charlotte Islands), The Netherlands, Australia, Cuba, Senegal, France, Guinea, Italy, Norway, Cameroon, Columbia, Madagascar, Japan, Spain, Haiti, Burma, Chile, South Korea, Iran, Bangladesh, Venezuela in: J.R.V. Prescott, *The political geography of the oceans*, London-Vancouver 1975, pp. 84, 86, 88, 91; W.M. Reisman, G.S. Westerman, *Straight baselines in international maritime boundary delimitation*, London 1992, p. 108 and next; R.D. Hodgson, L.M. Alexander, *Towards an objective analysis of special circumstances*, LS IURI - Law of the Sea Institute, University of Rhode Island, occasional paper No. 13 1972, p. 23 and next; problem of the baseline in light of UNCLOS (1982) solutions - mainly art. 5, 6, 7, 9, 10, 11, 13, 14, 16, 47, 50 see comments *The law of the sea. Baselines: an examination of relevant provisions of the United Nations Convention on the law of the sea*, New York 1989, p. 1 and next.

[70] The relevant text of the Proclamation was: "...the continental shelf may be regarded as an extension of the land-mass of the coastal nation and thus naturally appurtenant to it, since these resources frequently form a seaward extension of a pool or deposit lying within the territory...." On the same day, besides the Presidential Proclamation No. 2667 a second, No. 2668 Proclamation was published. Full texts and titles in: NDLS (New directions in the law of the sea, documents), Vol. 1, London 1973, p. 106-109; see M.S. Ball, *The law of the sea, federal state relations and the extension of the territorial sea*, Athens 1978, p. 8-9; R.P. Anand, *Legal regime of the seabed and the developing countries*, A.W. Sijthoff - Leyden 1976, p. 32-33.

[71] See R.B. Krueger, *Study of the outer continental shelf lands of the United States*, Vol. 1, Los Angeles 1968, p. 13-14; legislative practice of 15 Latin American states with respect to the continental shelf, beginning from the Mexican Declaration (20 X 1945): H.L. Villamil, *La Plataforma Continental Y Los Problemas Juridicos del Mar*, Madrid 1958, p. 56 and next.

[72] More in M.W. Mouton, *The continental...*, RCADI, p. 369 and next: it is thought (e.g. A.G. Robles) that the practice of these states, influenced by Trumans proclamation, first began to shape the new legal structure of the continental shelf in connection with the epicontinental sea/territorial sea. See W.C. Extavour, *The exclusive economic zone. A study of the evolution and progressive development of the international law of the sea*, Geneva 1979, p. 73-78; see resolutions: IAJC (Inter-American Juridical Committee), IACJ (Inter-American Council of Jurists) [in:] *ibid.*, p.79 and next; F.O. Vicua, *The exclusive economic zone. A Latin American perspective*, Colorado 1984, p. 12-24; A.G. Robles, *La Conferencia de Ginebra y La Anchura del Mar Territorial*, Mexico 1959, p. 279 and next.

[73] M.W. Mouton, *The continental...*, RCADI, p. 375.

- [74] See J.L. Bustamante Y Rivero, *Principios Juridicos que Sustentan la Tesis del Peru Sobre el Mar territorial de 200 Millas*, FDP - *Fundamentos de la Doctrina de las 200 Millas Peruanas*, Lima 1973, p. 137 and next; E.F. Costa, *El Nuevo derecho del Mar. El Peru y las 200 Millas*, Lima 1979, p. 51 and next.
- [75] M.W. Mouton, *The continental...*, RCADI, p. 374.
- [76] This motive is also strongly accentuated in the memorial of Tunisia. More in: I.C.J. Pleadings, *Continental shelf (Tunisia - Libyan Arab Jamahiriya)*, vol. 1, p. 155-156.
- [77] G. Scelle, *Plateau continental et droit international*, RGDIP - "Revue Générale de Droit International Public" 1955 No. 5, p. 154; G.I. Tunkin, *Teorya mezhdunarodnogo prava*, Moscow 1970, p. 109, (in Russian); it seems that while ILC in 1956 and ILA in the years 1950/52/54 showed some caution in this respect, the ITJ in 1969, seeing the increasing practices of states, used the dynamic and functional interpretation of CG IV (1958) reaching such a conclusion. Arguments and literature: see G.F. Kalinkin, *Rezhym morskikh prostranstv*, Moscow 1981, p. 144-148 and 189-190 (in Russian).
- [78] L.F.E. Goldie, *The contents of Davy Jones locker - a proposal regime for the seabed and subsoil*, RLR - "Rutgers Law Review" vol. 22, 1967, p. 1 and next.
- [79] I.C.J. Pleadings, *Continental shelf (Tunisia - Libyan Arab Jamhiriya)*, vol. I, p. 162.
- [80] *Ibid.*, p. 163; as it was rightly pointed out, this is a problem of the relationship between Earth sciences and international law, and is expressed in the formula "...the law is concerned with real things such as mineral resources, and cannot evolve hypothetical concepts and seek to make them operational without taking into account the scientific facts that constitute reality". More in: D.P. O'Connell, *The international law of the sea*, vol. I, p. 440-441.
- [81] "§1. The continental shelf of a coastal state contains the seabed and subsoil of undersea areas outside its territorial sea through natural prolongation of its land territory, up to the external edge of the continental margin, or to a distance of 200 Nm from the baseline from which the territorial sea width is measured, if the external edge of the continental margin does not reach that distance". See text: Doc. A/CONF.62/122 - UNCLOS (1982) [in:] OR III UNCLOS, vol. XVII, New York 1984, p. 168.
- [82] See the history of article 76 in: J. Symonides, *Geographically disadvantaged states under the 1982 Convention on the Law of the Sea*, Extract from the *Recueil de Cours*, 1988 (I), p. 343-350. Discussion of the criteria for the external boundary (art. 76) see also: A. Reynaud, *Le Plateau Continental de la France*, Paris 1984, p. 12-13; graphic presentation: K.O. Emery, *Geological limits of the continental shelf* [in:] *Ocean development and international law*. "The Journal of Marine Affairs", vol. 10, 1981-82, p. 8 (Fig. 5); E.D. Brown, *The international law of the sea*, vol. I, Aldershot, Brookfield 1994 (Fig. 10.1), p. 141; relations between EEZ (Exclusive Economic Zone) and continental shelf - graphic presentation - in: A.S. Laughton, *The EEZ, the continental shelf and modern surveying techniques*, AUT, p. 72 and 75.