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The Features of Modeling the Sectoral Division of Maritime Territory Between Littoral States

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Abstract: In the article, we consider the peculiarities of median line method applied for delimitation of maritime boundary between littoral countries. A special emphasis is placed upon the fundamentals of the UN Convention on the Law of the Sea signed in 1982 concerning the delimitation of maritime boundary. Besides, the advantages of the median line method are assessed in the article. The analyses described in the article definitely show that the median line method is imperfect. In the end of the article, the main reason for this imperfection is noted: it is impossible to take stock of configuration, extension and mutual bracing of the basic (coastal) lines of littoral countries. Instead of this, the authors offer a new method that is called a coastline method.

Key words: Territorial sea · Contiguous zone · Exclusive economic zone · Continental shelf · Median line method

INTRODUCTION

The 1982 UN Convention on the Law of the Sea [1] (hereinafter called Convention) consists of 17 parts including 320 articles and 9 appendixes. Generally speaking, the Convention regulates all political, legal, economic, ecologic, technologic and other aspects connected with the usage of maritime space.

The Convention gives a well-defined classification of all basic criteria of maritime zones of a littoral country. They are territorial sea (art. 5), contiguous zone (art. 33), exclusive economic zone (art. 57), continental shelf (art. 76) etc.

It should be noted that territorial sea, contiguous zone, exclusive economic zone and continental shelf are given to all islands (except artificial islands and constructive works and also rocks unsuitable for human life and independent economic activity (art. 121). And, they are defined on the same grounds that can be applied to other land territories. The Convention establishes quite a full border for the above-mentioned zones on the whole. The delimitation methods for the sectoral borders between neighbouring states with opposite or adjacent coasts are mentioned in articles 15, 74 and 83.

Article 15 of this Convention contains the following: "*…where the coasts of two States are opposite or adjacent to each other, neither of the two States* ***is entitled****, failing agreement between them to the contrary, to extend its territorial sea* ***beyond the median line*** *every point of which is equidistant* ***from the nearest points*** *on the baselines from which the breadth of the territorial seas of each of the two States is measured*".

Articles 74 and 83 of this Convention are dedicated to delimitation problems of exclusive economic zone and continental shelf, respectively. The articles have almost the same wording. They are purely recommendatory and call to solve the delimitation problem of continental shelf and exclusive economic zone by an agreement based on international law with the purpose of an equitable solution [1]. The problem concerning the delimitation of contiguous zone remains open. It was not reflected in the 1982 UN Convention on the Law of the Sea. Maybe this is the reason why the method described in article 15 is often used for such cases. In this method, median line plays the role of delimitation border for maritime zones between littoral countries. This method, which is usually called ***the median line method***, is the subject of this paper.

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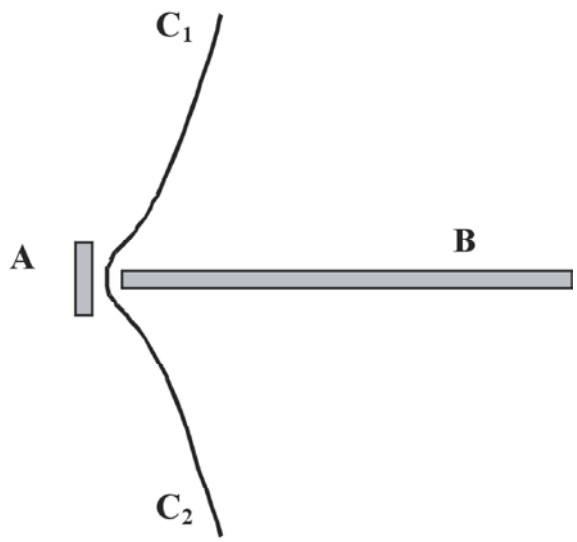

Fig. 1:

MATERIALS AND METHODS

The formulation of the median line method (art. 15) shows that only the nearest points of base coastline are taken to define sectoral border points of maritime zones (for instance, territorial sea) between neighbouring littoral states. Other points are not taken into account. Why? Theoretically, all points of a base coastline are of certain importance. Each point of a base coastline, regardless of whether it is the nearest or the outermost one, should contribute into the process of maritime zones separation between littoral states. We are sure that corrupt results may be received by considering only the nearest points without considering other neighbouring points and far points. The aggregate of these points defines the configuration of base coastline. This can be illustrated by simple examples of sectoral separation of maritime zones.

For convenience, we'll study a case of island states.

Suppose two rectangular islands belonging to different states are situated side by side, as it is shown on Figure 1. They have the same width but different length. Suppose the left island belongs to state *A* and the right one belongs to state *B*. According to paragraph 2, article 121 of the Convention, these islands must have their own territorial sea, contiguous zone, exclusive economic zone and continental shelf. If the distance between these islands is less than 24 miles, it is necessary to find a separating boundary at the territorial sea between states *A* and *B*. If the distance between these islands is about 200 miles, the subject for delimitation is an exclusive economic zone etc.

Let us apply the median line method to define dividing boundaries of maritime territory between islands *A* and *B*. The boundary found has a shape of curve C_1C_2 (Figure 1). It is considerably curved in the direction of island *B*. As one can see on this figure, island *B* receives a much smaller maritime space. Such division is obviously unfair. No doubt, state *B* will express a righteous discontent.

It should be noted, that this simple example is a convincing and visual proof of the imperfection of the median line method. While analyzing many of such examples, one can become convinced that the median line method can lead to a very distorted picture if applied to real situations when coastlines have extremely complex configuration.

We are sure that the main reason of the imperfection of the median line method is the fact that the length and configuration of base coastline and their relative positions are not fully taken into account. In our view, clearing these troubles, which is the aim of this paper, can cause a more accurate and equitable division of maritime zones between neighbouring littoral states.

Main Part: In the offered development of the modeling process of sectoral division of maritime territory, all littoral states receive equal conditions by means of excluding such factors as population size, total area, political and military capabilities and other characteristics of a country because they shall inevitably lead to distorted pictures. Besides, the factor of natural resources in some region of divided zones is also excluded because further discovery of new deposits can provoke new division. As a result, the sole not excluded factor is the presence of base coastlines. Consequently, the process of maritime territory division should be modeled by the base coastlines with full consideration of their length, configuration and relative positions.

It is but natural that the more divided maritime zone borders this country, the greater should be the territory given to this country and vice versa [2-6]. This means that a base coastline is a source for the interests of a country in one or another region of a maritime territory. These interests are more valuable if a considered local maritime region is close to the coastline of this country. But they can be less valuable if a considered maritime region is far from it. Consequently, the size, the direction and other characteristics of the ***field of interest*** for each littoral state in some maritime region should be determined by the length and configuration of the base coastline and their relative position. Now we'll find the size of these fields of interest.

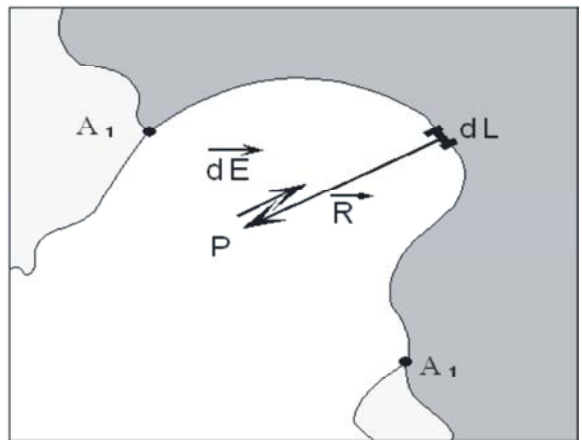

Fig. 2:

Suppose coastline A_1-A_1 (Figure 2) belonging to state A creates a field of interest on the surface of a maritime zone. Let us designate the power characteristic of this field by dA at arbitrary point P created by infinitely small segment dL of coastline A_1-A_2. In this case, vector $d\vec{E}$ is directed at the centre of segment dL and its value is directly proportional to dL, i.e.

$$dE \sim \lambda dL \tag{1}$$

where [lambda] is a coefficient expressing the ability of coastline A_1-A_1 to create a field of interest. As it was said above, this power characteristic depends also on R which is a distance from element dL to studied point P. Their dependence looks like this:

$$dE \sim \frac{1}{R^{\alpha}}. \tag{2}$$

Let us find factor [alpha]. The field stream created by element dL through any sphere surrounding this element has one and the same value [7, 8]. That is why

$$dE \cdot 4\pi R^2 = const \quad \text{or} \quad dE = \frac{const}{R^2}$$

Therefore we get that $\alpha = 2$. Using this value, we'll get from (1) and (2)

$$dE = \frac{\mu\lambda dL}{R^2}, \text{ or in vector form } d\vec{E} = -\mu\frac{\lambda dL}{R^3}\vec{R}. \tag{3}$$

In order to find the general power characteristic of total field created by coastline A_1-A_1, we'll sum up all contributions of all elements dL.

$$\vec{E} = \int_L d\vec{E} = -\mu\lambda\int_L \frac{dL}{R^3}\vec{R} \tag{4}$$

In order to find the power characteristic of the field of interest created by other littoral countries, we'll copy expression (4). This maritime zone is mutual for them. That is why the proportionality factors for any base coastline should be constant, regardless of both what state it belongs and their length and configuration. That means:

$$\lambda_1 = \lambda_2 = ... = \lambda_i = \lambda = const,$$
$$\mu_1 = \mu_2 = ... = \mu_i = \mu = const.$$

Consequently, we'll get from (4):

$$\vec{E}_i = \int_{L_i} d\vec{E}_i = -\mu\lambda\int_{L_i} \frac{dL_i}{R_i^3}\vec{R}_i, \tag{5}$$

where i is the index that shows a sequence number of the littoral country. Integral is taken along the full length L_i of coastline A_1-A_i.

Using this system of equations (5), it is possible to find the boundary of sectoral division of this maritime space between littoral states with contiguous and opposite coastlines. Besides, we should particularly note that equation system (5) takes into account the length and configuration of the base coastline of each country (and their relative position) in full volume with n exclusions.

It is impossible to solve equation system (5) analytically because base A_i-A_i have a complex configuration. So, we'll use computer.

Computation algorithm. At first, we'll get the fix of all points of base coastline A_i-A_i that are at an equally small distance ΔL from each other. At the same time, $\Delta L = const$. It should be mentioned that the shorter distance ΔL, the more accuracy of the computation. The point data are stored in computer memory.

Then we take arbitrary point P on the surface of a pond. Using equation (5), we'll find power characteristics $\vec{E}_i$ of fields created by base coastlines A_i-A_i of these states in this point separately. After that we compare them. If a power characteristic of the field of interest belonging to one of the countries in this point is bigger than power characteristics of other countries' fields separately, then this point is considered to belong to this country. Then we take another arbitrary point P and repeat the computation. If power characteristics of two countries are equal in this point, this point is considered to belong to both countries simultaneously. It means that it is on the border of sectoral division. But if power characteristics of

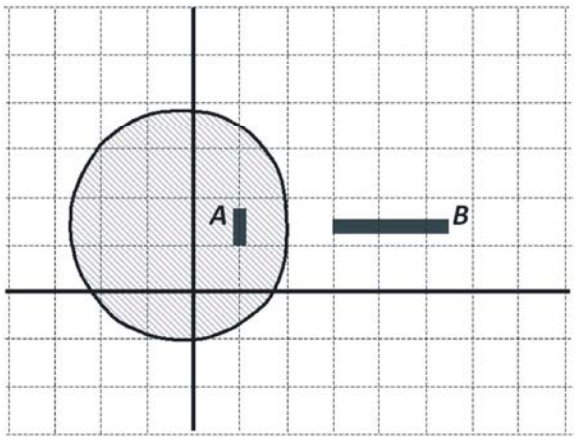

Fig. 3:

three countries are equal in some point, the borders of three countries cross in this point, etc. If continuing the computation, we'll get the set of all points that gives a border of sectoral division of maritime zone between neighbouring littoral countries. In a word, each point of division boundary of maritime space between littoral countries is determined by the principle of equality of power characteristics belonging to the fields of interest of two or several countries in this point.

This is the same as a mathematical formulation of the words said by many known political scientists and geopolitics scientists. For example, N. Spykman wrote: "…boundaries are the ***power lines*** *where mutual strain between states is neutralized", "…from the point of view of international politics, a boundary is an expression of relevant* ***power relations*** *as lines where the conflict strain is balanced", "…the quality of a boundary is not expressed in the strategical value categories of a boundary line but in the categories of* ***power potential*** *of the territory adjacent to the boundary". According to R. Strausz-Hupe:"…boundaries determine the division of political entities and express* ***power relations*** *between states". A similar definition was given by Y.V. Tikhonravov: "…****power balance*** *and* ***dynamic equilibrium of interests*** *determine the viability of some boundaries…"* [9, 10, 11].

It follows from (5) that the advantage of this method over the median line method consists in the fact that the length and configuration of all base coastlines and their relative positions are fully taken into account while defining the borders of sectoral division of maritime territory between littoral countries. That is why we give the offered method a name of a **coastline method**.

Now let us consider the practical application of the coastline method that we offer. For illustration purpose, we'll consider the case of islands shown on Figure 1. In order to simplify calculations, we'll take a distance between the islands to be equal to 7.5 miles, the width of the islands is equal to 1 mile and the length of the first and the second islands is 3 and 10 miles, respectively.

Using the offered coastline method, we'll find a new boundary of maritime space division between islands *A* and *B* belonging to different states. The calculated boundary has quite a different appearance of a closed curve (Figure 3).

In Figure 3, each coordinate cell has equal to 4 miles. One should observe that this closed curve is a set of points in each of which power characteristics of the fields of interests have the same value. Outside the hatched area, the power characteristic of the field of interests created by island *B* is bigger than the power characteristic of the field of island *A*. Inside the hatched area, i.e. inside the closed curve, everything is vice versa: the power characteristic of island *A* is bigger than the power characteristic of island *B*. Consequently, the hatched area completely belongs to island *A*. The maritime territory outside the hatched area belongs to island *A*. It should be noted that we received a more impartial picture of the division of maritime territory between islands *A* and *B* than the picture shown in Figure 1 where the median line played the role of boundary.

Now it is not hard to compute a boundary of sectoral division of territorial sea, contiguous zone, exclusive economic zone and continental shelf. The received picture is shown in Figure 4. The scale of Figure 3 and Figure 4 is identical. In Figure 4, the maritime zones marked by 3 и 4 are the contiguous zones of islands *B* and *A*. One should notice that the maritime space marked by 5 in Figure 4 and situated outside the contiguous zone 3 of island *B* is its exclusive economic zone. As it can be seen, island *A* does not have its own exclusive economic zone in this case because, according to art. 55 of the Convention, it must be adjacent to the territorial sea of this island.

CONCLUSION

It should be noted that in this article, for simplicity, we studied a case of maritime division between two islands, i.e. two island states. Actually, we think that the coastline method is universal. It can be used in any case, specifically for the division of maritime space between hinterland states, island states and archipelagic states etc. The universality of this method also consists in the possibility to use it for the division of any kind of maritime territory: territorial sea, contiguous zone, exclusive economic zone or continental shelf etc. The chief distinction of the offered method over all other methods, particularly the median line method, is the fact that a

sectoral division boundary sought for by this method is defined on the basis of complete account of the length and configuration of base coastlines of each state, with consideration of their relative positions. Besides, we'll note that the offered method gives the opportunity to define a boundary with any required accuracy.

Resume: It is also notable that, in real politics, the economic, political, ecological and other factors (that are necessary to be taken into account) will play a certain role in making final decisions while dividing maritime zones between littoral countries. We think that the coastline method we offer can become a basis for such decisions.

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