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Study on the Seismogenic Mechanism of the Earthquake Mw6.9 in 2014 in the Aegean Sea Seismic Cone

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Abstract

In accordance with the Seismo-Geothermics theory about methods of intracrustal strong earthquake and volcano prediction, we use the ANSS earthquake catalogue from the Northern California earthquake data center and the EMSC earthquake catalogue from the European-Mediterranean Seismological Centre to study the seismic activities of the Turkish Branch Seismic Cone in the Mediterranean Seismic Cone and the following Aegean Sea Seismic Cone, and show reproduction through graphics and animation, the seismogenic process and seismogenic mechanism of the earthquake Mw6.9 on May 24, 2014 in northern Aegean Sea. It was concluded that the energy of strong earthquake of magnitude around 7 in Aegean Sea was probably from energy transfer and accumulation in deep mantle and incentive lithosphere in the way of wave pattern, and then the strong earthquake occurs suddenly in search of the weak parts of the surface structure. The purpose of this paper is to open a hole in the traditional seismic genesis, and it is beneficial to the further research on the theory and method of earthquake prediction. It is our first attempt to study this case and it needs further examination. In this paper, we divide the Turkish Branch Seismic Cone of the Mediterranean Seismic Cone into 4 tertiary seismic cones, and we show a preliminary seismo-tectonic model of Aegean region. It will be conducive to seismic monitoring and earthquake prediction research in Greece, Turkey, Romania and Poland regions. At present, the world's earthquake prediction has little effect, and it even tends to be not cognitive. Innovative thinking is the only way out.

Keywords

Seismo-Geothermics Theory, Seismic Cone, Turkey, Aegean Sea, Subcrustal Earthquake, Intracrustal Strong Earthquake, Seismogenic Mechanism

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1. Introduction

Using the ANSS earthquake catalogue of magnitude 4+ from the Northern California earthquake data center and the EMSC earthquake catalogue of magnitude 1+ from the European-Mediterranean Seismological Centre, according to the author's about Seismo-Geothermics theory and method [1]-[3], the seismic activity space distribution and time course of earthquakes in the Turkish Branch Seismic Cone of the Mediterranean Seismic Cone are studied and the seismogenic process of the earthquake of magnitude Mw6.9 on May 24, 2014 in northern Aegean Sea is given in this paper.

So far, people often think that earthquake preparation and occurrence are due to the strain energy accumulation of near surface geological tectonic movement (fault or fold), and it requires assumptions of the subduction zone and interpretation by phase transformation, so are intracrustal strong earthquakes and deep seismic activities. However, the results of this study indicate that the energy accumulation of intracrustal strong earthquakes can be derived from the upper mantle, and intracrustal strong earthquakes may be related to the crustal structure just before its occurrence. This result opens a small gap to the traditional seismic genesis, and may also change the theory and method of earthquake prediction.

2. Data Selection and Research Methods

The data of the seismicity research of Turkey and the Aegean Sea in this paper is local and the research method is global. We have made some experimental examples [4]-[8].

2.1. Research Methods

The research method used in this paper is based on the theory and working methods of Seismo-Geothermics theory proposed by the author.

Seismo-Geothermics theory suggested that global strong earthquakes and volcanic activity are control by a hot engine belt tectonic system and a cooling seismic belt tectonic system in the Earth; the hot engine belt is composed of 24 known seismic cones defined by the author, which controls all global deep earthquakes, 92% of the intracrustal strong earthquakes, and 83% of volcano activities. It is a dynamic zone of global geological disasters with M-type distribution on the Earth; the cooling seismic belt is mainly along the ocean ridge appearing shallow earthquakes and volcanic activity and is an adjustment of the global geological disaster zone with W-shaped distribution (**Figure 1**).

The concept of the Seismic Cone structure, which was called as seismic cylinder or seismic mantle plume, is constructed compositely by one or more monomer seismic cone, and the known maximum depth is 740 km. Single seismic cone structure is an inverted cone integrated by deep seismic source density with independent active layers (with constant heat layer), energy storage layer and dissipative layer of affected areas. The earthquake is marked by the heat driving from the bottom and up layer by layer. The heat accumulation in the storage layer provides thermal mass and the heat energy of volcanic eruption, and/or it changes into needed mechanical energy for strong earthquake in the crust, pushed to the surface tectonic activities.

At present, the seismic prediction method of Seismo-Geothermics theory is only applicable to the hot engine belt. For the known 24 seismic cones, the methods of work are:

- To collect information of earthquake and volcano activities in related geographic range.
- To use temporal and spatial analysis to analyze the seismic data; to identify rationality of cone structure and division of internal monomer cone structure.
- To determine the future activity intensity, abnormal possible place, and abnormal periods on seismic analysis of spatial and temporal of subcrustal earthquakes.
- To comprehensively analyze the anomalies, and to determine the possibility of volcano eruption or possibility of intracrustal strong earthquakes.
- To analyze the Earthquake cause and summarize cases; to improve principle and working method of Seismo-Geothermics theory.

2.2. Data Selection

The research scope of this paper is the Aegean Sea and the surrounding area, which is limited to the Turkish Branch Seismic Cone of the Mediterranean Seismic Cone No. 19, namely, 30˚ - 55˚N, 17˚ - 39˚E.

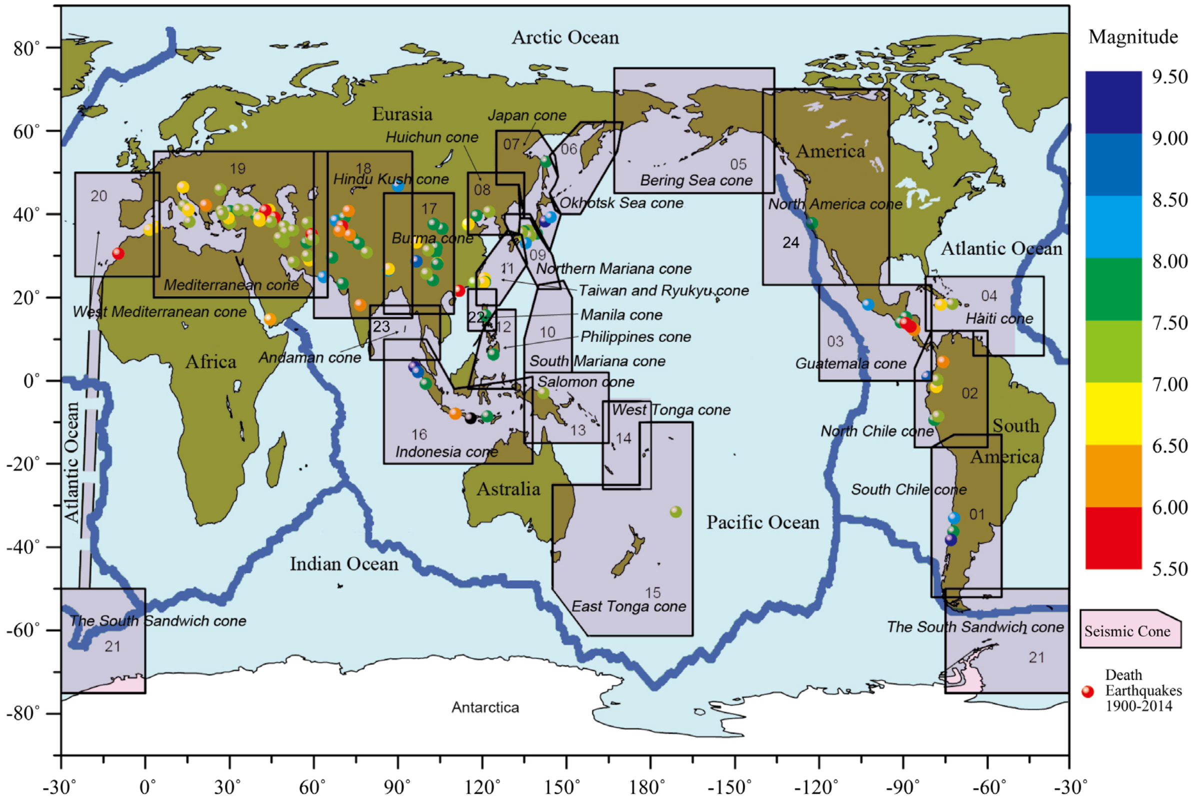

Figure 1. Schematic diagram of global structural system by Seismo-Geothermics theory.

The strong earthquake data is from earthquake catalogue of ANSS by the Northern California earthquake data center and we have got data of 11,653 earthquakes of magnitude 4 and above between 1963 to 2016 years. Among them, there are 10,726 earthquakes of M4 - 4.9, 851 earthquakes of M5 - 5.9, 72 earthquakes of M6 - 6.9 and 4 earthquakes of M7 - 7.9. The maximum magnitude is 7.7 and the maximum focal depth is 226 km.

The microseismic data is from Mediterranean seismic data center (EMSC) and it provides 97,536 earthquakes of magnitude 1 and above in the period from Oct.1, 2004 to Oct.1, 2015. Among them, there are 4226 earthquakes of M1 - 1.9, 62,110 earthquakes of M2-2.9, 28,642 earthquakes of M3 - 3.9, 2393 earthquakes of M4 - 4.9, 150 earthquakes of M5 - 5.9, and 15 earthquakes of M6 - 6.9. The maximum earthquake is 6.9 and the maximum focal depth is 667 km.

The number of earthquakes of M2.5 and below is too few apparently (**Figure 2**), but the space distribution still has statistical significance, and it fails to eliminate.

3. Seismic Activity of the Turkish Branch Seismic Cone

The Turkish Branch of the Mediterranean Seismic Cone, or the Turkish Branch Seismic Cone for short, is a second level branch cone of the Mediterranean Seismic Cone No.19 in global 24 seismic cones [2] [3].

Figure 1 shows the global earthquakes with 1000 or More Deaths in 1900-2014 [9] and the number of death earthquakes is the largest in the Mediterranean region. **Figure 2** shows the reliability of the seismic network monitoring in the Mediterranean region since Oct.1, 2004. Therefore, this paper focuses on the study of the seismic activity of the Turkish Branch Seismic Cone, which may help to find the solution of earthquake prediction, and also help to enhance the security of human life in the area.

3.1. The Mid-Strong Earthquake Activity of the Turkish Branch Seismic Cone

According to the ANSS earthquake catalogue of the Northern California earthquake data center, the geographic distribution and the stereo image in the Turkish Branch Seismic Cone are shown in **Figure 3** and **Figure 4** respectively.

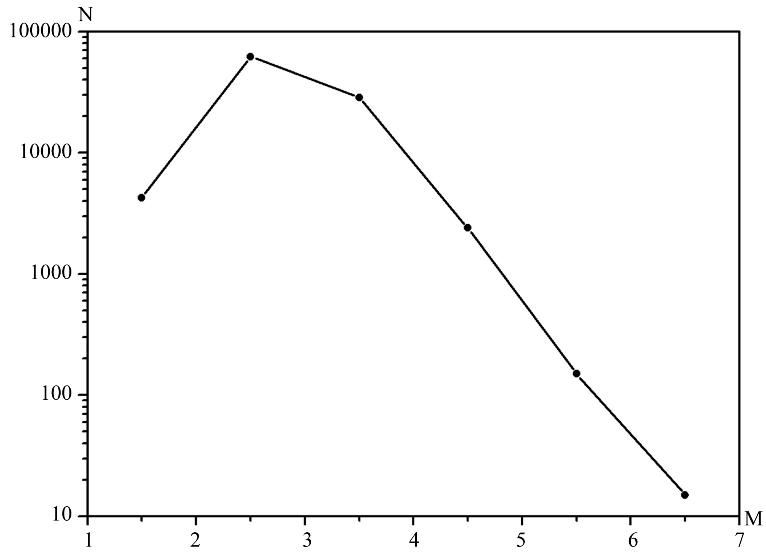

Figure 2. The repetition rate of the Turkish Branch Seismic Cone.

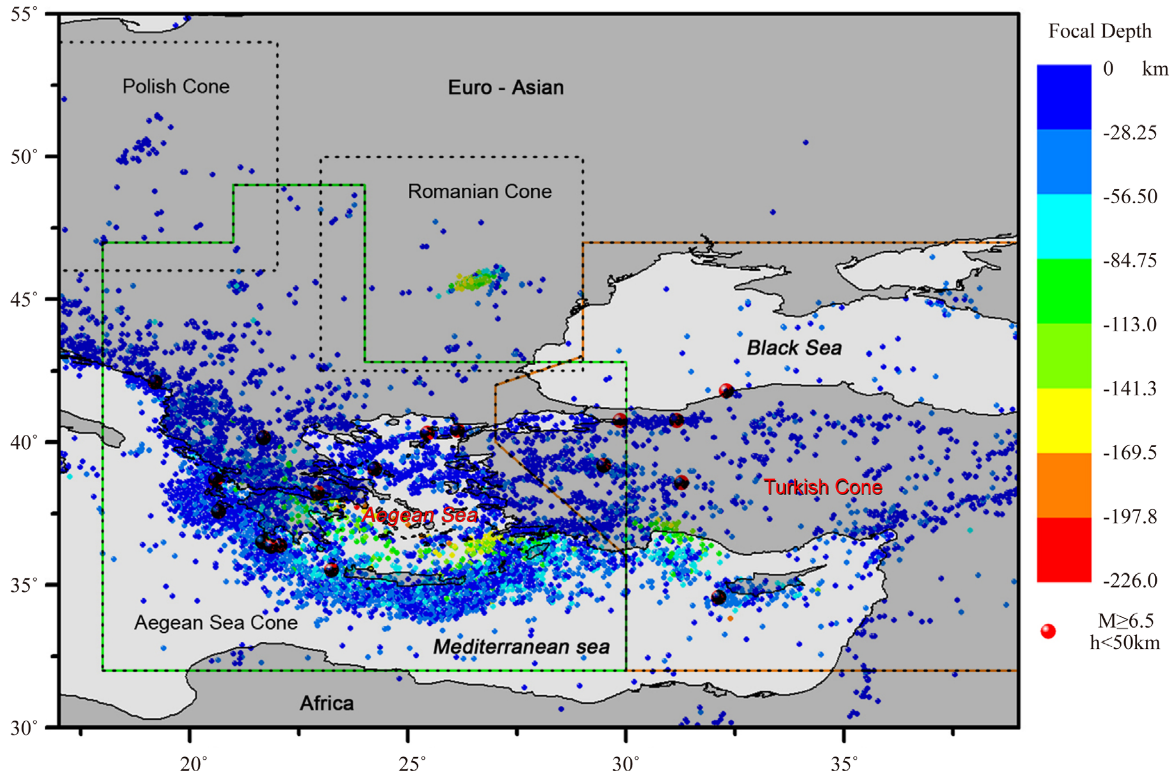

Figure 3. Geographical distribution map in the Turkish Branch Seismic Cone (Jan.1, 1963 - Mar.2, 2016, M ≥ 4).

For Figure 3, the earthquakes are mainly distributed along the north shore of the Mediterranean Sea where the famous Mediterranean-Himalaya zonal belt lies on [10] [11]. Around Aegean Sea, the seismic activity, which is a ring-like distribution, and the Solomon's ring-like distribution constitute two largest earthquake landscape structures on the Earth.

Figure 4 shows the space distribution of Turkey Branch earthquakes. There are several inverted cones, which are formed by the focal dense collective of the Turkey Branch. This is consistent with the author's concept about

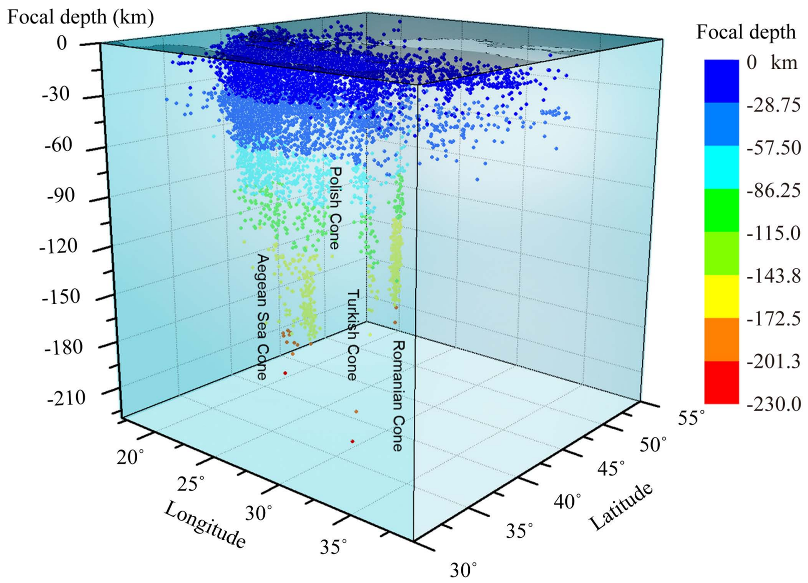

Figure 4. The three-dimensional distribution map in the Turkish Branch Seismic Cone (Jan.1, 1963 - Mar.2, 2016, M ≥ 4).

the seismic cone and its pillar structure [3]. The cone forms are from seismic data of more than 50 years and the image is stable.

Figure 3 and **Figure 4** show that the Turkish Branch Seismic Cone can be subdivided into a number of single seismic cones (after detailed).

3.2. Analysis of Microseismic Data of the Turkish Branch Seismic Cone

According to the ESMC earthquake catalogue from the European-Mediterranean Seismological Centre, the geographical distribution and the three-dimensional image of the Turkish Branch Seismic Cone are shown in **Figure 5** and **Figure 6** respectively.

Comparing **Figure 4** with **Figure 6**, the images are basically similar, which shows that the compiled principles of two sets of earthquake catalogues are basically the same. The difference between the two sets of earthquake catalogues lies in the accuracy of seismic observation. The maximum focal depth is more than 600 km from ESMC earthquake catalogue but it did not change the position and shape of the cones.

3.3. Seismic Cone Division of the Turkish Branch Seismic Cone

See **Figure 3**, **Figure 4** and **Figure 6**, the Turkish Branch Seismic Cone can be divided into 4 three-level seismic cones, such as Aegean Sea, Turkey, Romania, and Poland, which are divided by the data of subcrustal earthquake activities (h > 35 km) of microseismic data in **Figure 7** and the results of all of the figures are consistent. Each cone has the basic features of a single seismic cone, such as its pillar and its independence of affected area [3]. At present, the data of the Aegean Sea Seismic Cone and the Turkish Seismic Cone are rich enough, but the other two seismic cones are only beginning to take shape because of the insufficient information.

In **Figure 7**, the dashed line indicates the approximate boundary of the affected area (**Table 1**), the yellow arrow indicates the dip direction of the cone pillar (also called the intrinsic profile). The intrinsic profile of seismic cone is directed to the deep seismic active area, and is penetrated through the axial direction of cone. Along the section of the intrinsic profile, it can be painted in the only one section, which senses the individual Benioff section of monomer seismic cone. The intrinsic profile is one of the basic attributes of seismic cone structure. Its physical meaning and tectonic significance will be lost outside the seismic cone.

To the detailed studies of earthquakes, it is preferably microseismic data below magnitude 4 synchronously. However, the Mediterranean seismic data center provided a formal earthquake catalog just since October 2004, which showed about 7 strong earthquake occurred during the period only in the Aegean Sea. Because of this, the

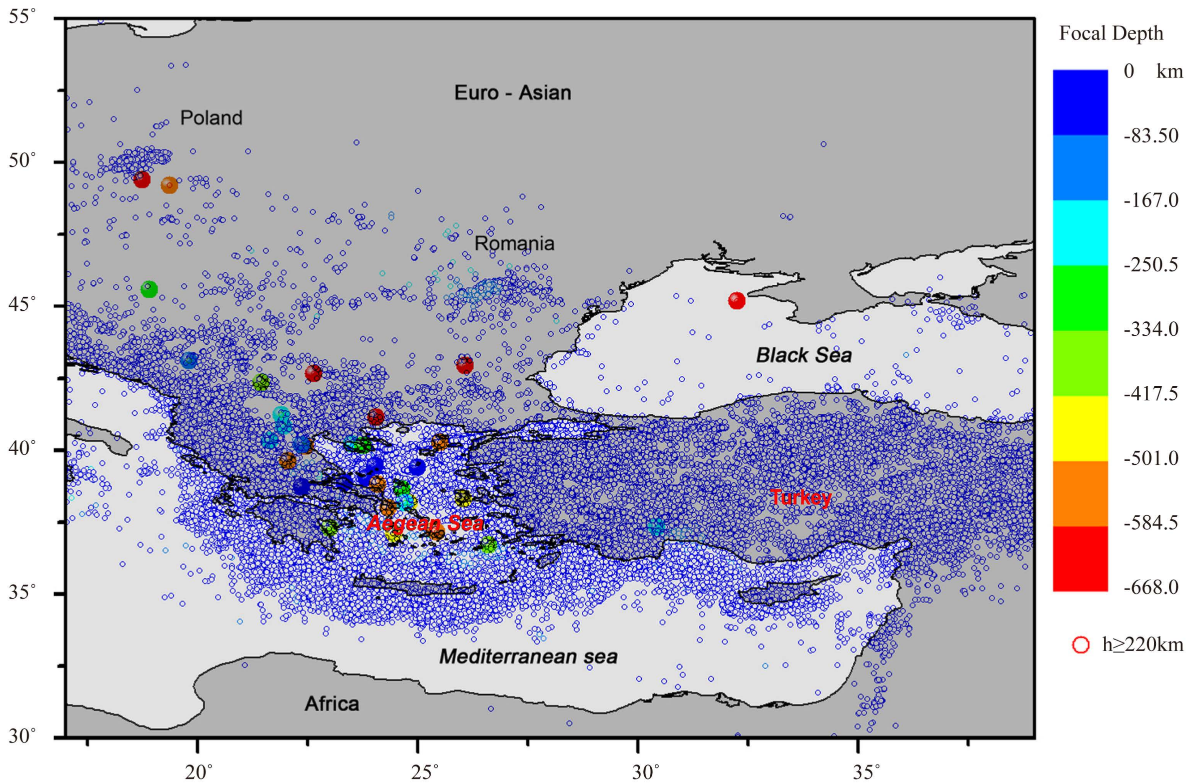

Figure 5. Geographical distribution map of microseismic activity in the Turkish Branch Seismic Cone (Oct.1, 2004 - Oct.1, 2015, M ≥ 1.7).

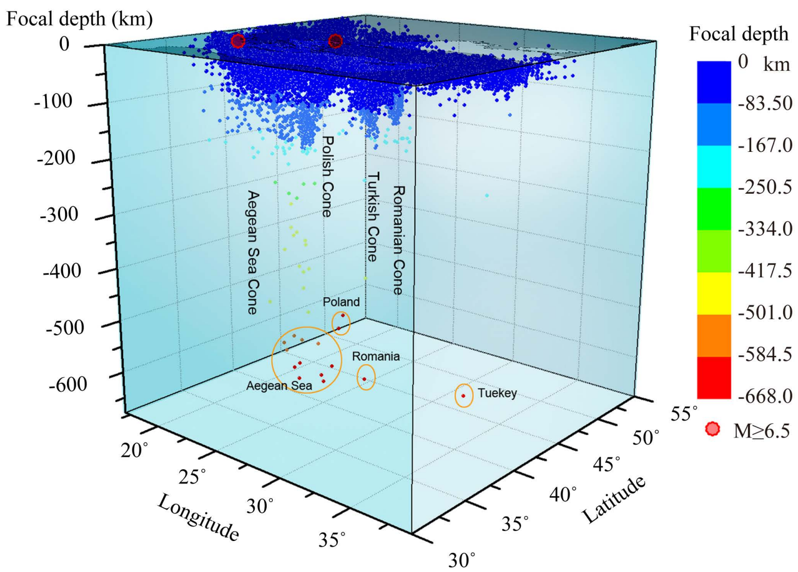

Figure 6. The three-dimensional distribution map of microseismic activity in the Turkish Branch Seismic Cone (Oct.1, 2004 - Oct.1, 2015, M ≥ 1.7).

following research is focused on earthquake situation of the Aegean Sea Seismic Cone by ESMC catalog.

4. Seismic Activity of the Aegean Sea Seismic Cone

According to the seismic cone division in Figure 7, the geographical range of the Aegean Sea Seismic Cone is

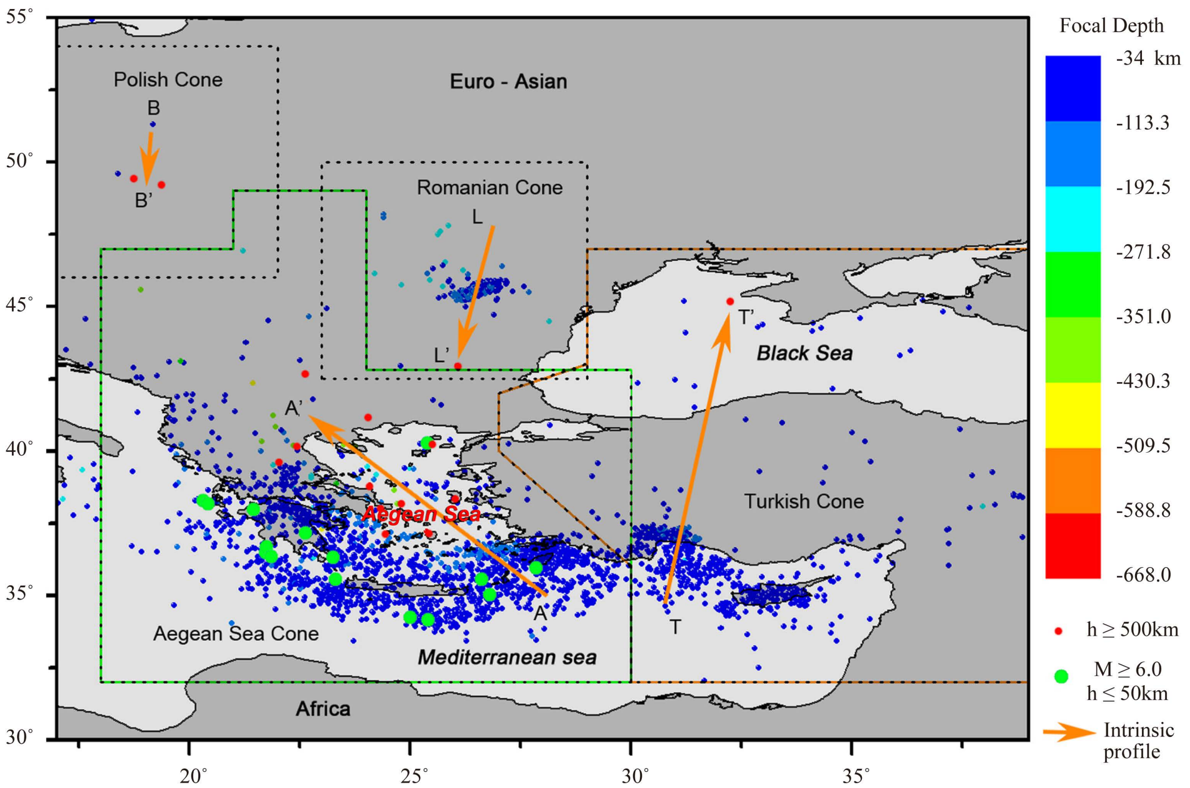

Figure 7. Earthquake distribution and cone division of the Turkish Branch Seismic Cone (Oct.1, 2004 - Oct.1, 2015, M ≥ 1.0).

Table 1. The seismic cone division of the Turkish Branch Seismic Cone (Oct.1, 2004 - Oct.1, 2015)*.

Seismic Cone	Polygon Coordinate Longitude, Latitude (degrees)	N	Hmax (km)	Mmax since 2004	Mmax since 1963
Aegean Sea	18, 32 - 30, 32 - 30, 42.8 - 24, 42.8 - 24, 49 - 21, 49 - 21, 47 - 18, 47	75,573	667	6.9	6.9
Turkish	30, 32 - 30, 36 - 27, 40 - 27, 42 - 29, 43 - 29, 47 - 39, 47 - 39, 32	31,225	650	5.9	7.7
Romanian	23 - 29, 42.5 - 50	2046	650	6	7.1
Polish	17 - 22, 46 - 54	1063	650	4.7	5.1

*N—number of earthquakes M1+, hmax—Maximum focal depth, Mmax—Maximum magnitude.

32 degrees to 44 degrees north and 18 degrees to 30 degrees east, including the Aegean Sea and its surrounding areas. Since 2004, there were 15 earthquakes with magnitude 6.0 or above occurred including 5 earthquakes of depth 35 km and above in the region, the maximum earthquake magnitude was 6.9 (**Table 2** and **Figure 8**). Therefore the Aegean Sea Seismic Cone is one of the frequent earthquake regions in the Turkish Branch Seismic Cone. Because the microseismic activity in this area is frequent, the following research is mainly about the subcrustal earthquake activity.

4.1. Subcrustal Seismic Activity of the Aegean Sea Seismic Cone Since 2004

The geographical distribution of the earthquake with a depth of more than 35 km in the Aegean Sea is shown in **Figure 8**. The earthquakes in the graph are roughly concentrated in two belts. Among them, the rose thick dashed line I is the Greek arc and the yellow thick dashed line II is the Volcano arc, which has been commonly defined. According to the distribution pattern of the subcrustal earthquakes, this paper considers that the rose

Table 2. The earthquake catalog of magnitude 6 or more in the Aegean Sea Seismic Cone (Oct.1, 2004 - Oct.1, 2015).

Date (yyyy/mm/dd)	Time (hh:mm:ss)	Latitude (Degrees)	Longitude (Degrees)	Magnitude (Mw)	Depth (km)
20060108	113453	36.31	23.25	6.7	60
20080106	051418	37.16	22.64	6.2	72
20080214	100922	36.57	21.75	6.9	30
20080214	120854	36.34	21.86	6.2	20
20080220	182707	36.47	21.71	6.2	26
20080608	122528	37.97	21.48	6.4	5
20080715	032635	35.96	27.86	6.4	60
20090701	093011	34.13	25.42	6.4	30
20110401	132911	35.54	26.63	6.0	60
20130615	161059	34.23	25.00	6.2	10
20131012	131154	35.56	23.31	6.4	47
20140126	135543	38.19	20.41	6.1	18
20140203	030845	38.26	20.32	6.0	2
20140524	092502	40.29	25.40	6.9	27
20150416	180744	35.03	26.81	6.1	30

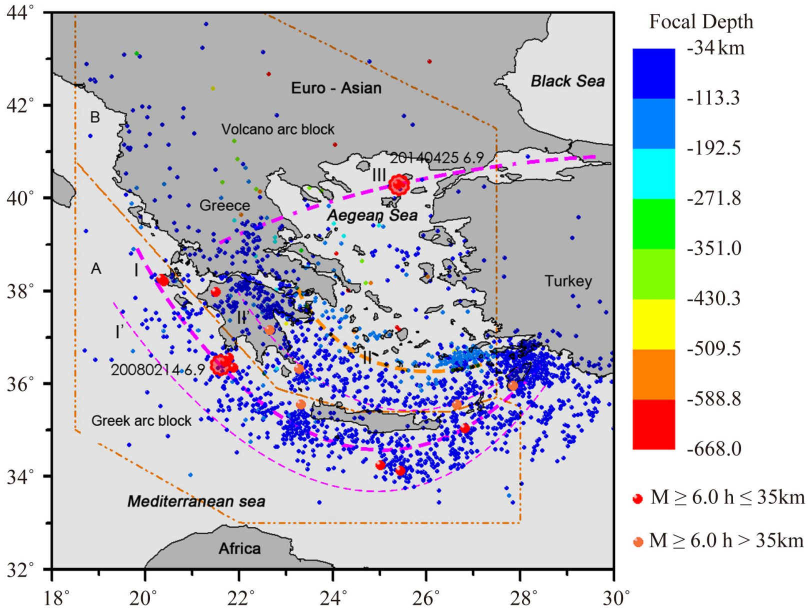

Figure 8. The geographical distribution of subcrustal earthquakes and intracrustal strong earthquakes in the Aegean Sea (Oct.1, 2004 - Oct.1, 2015, $M \geq 1.0$).

fine dashed line I' is the Greece front arc, and the yellow fine dashed line II', is the Volcano front arc. The rose thick dashed line III is the western section of the North Anatolian Fault in the graph performance for Volcano back arc, because the volcanic activities in the period of Neoid System in Aegean Sea are limited in the area between the volcanic arc and the North Anatolian Fault, and the volcano eruption times are late and late southward [12]-[45] (**Figure 9**). Volcanic activity is one of the basic characteristics of seismic cone structure [46] [47].

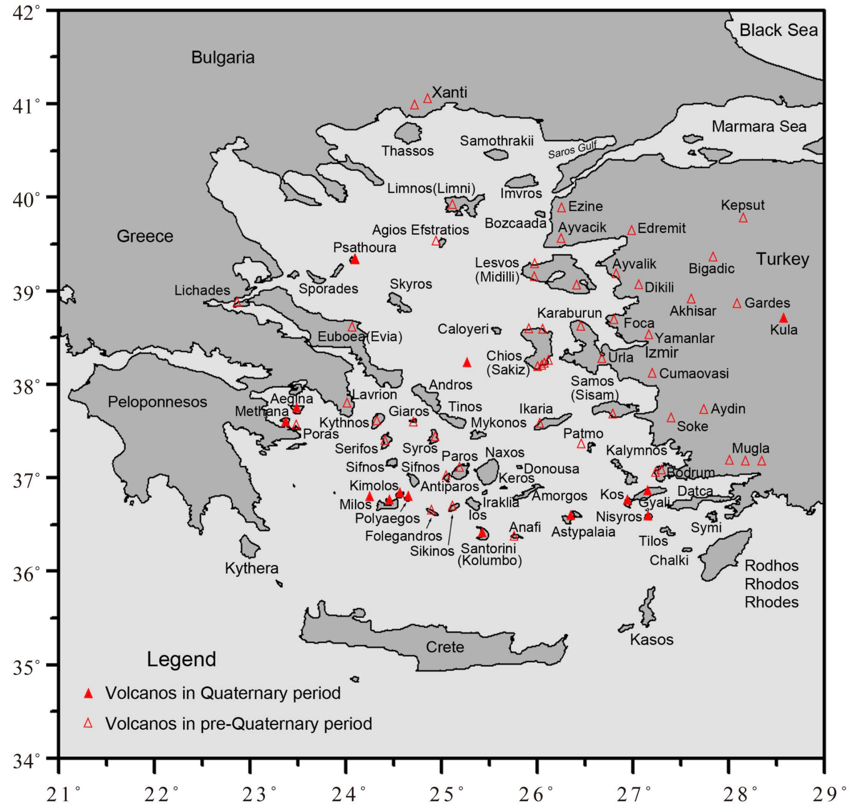

Figure 9. Volcanic activities in the Aegean Sea region.

Worth noting is that four dotted line I, I', II and II', consistently converge in Rhodes island area, Turkey, and scatter to the north-west direction uniform. It indicates that, there seems to be a trend of counter clockwise rotation in this volcanic area which is accurately the center of the Aegean Sea. Because of this case, the author will discuss it in another article.

In order to distinguish the difference between the seismic activity of the Greek arc and the Volcano arc, this paper divides the seismic activity into two blocks: the Greek arc block and the Volcano arc block, and count their monthly frequency (/0.1a) of the seismic activity under the crust, and was shown in **Figure 10**. From **Figure 10**, the case can be divided into two sections taking 2009 as node. In the early stage, the monthly frequency of the Greek arc block was significantly higher than that of the Volcano arc block, and the latter was the opposite. The ratio of the monthly frequency of the Greek arc block to the Volcano arc block is significantly greater than 1 in the early stage, and the latter is less than 1. Therefore, there is an earthquake Mw6.9 in February 14, 2008 in southern Greece early, but the later earthquake Mw6.9 in May 24, 2014 was in northern waters of the Aegean Sea. It seems that this figure is a basis for discrimination. We can also found in the figure that 2008 earthquake occurred after the high value of the frequency ratio, and the 2014 earthquake occurred after the high value end of the monthly frequency of the Volcano arc block, *i.e.* after the lowest level end of the monthly frequency ratio.

The time sequence diagram of the epicenter depth of 2005-2015 in the Turkish Branch Seismic Cone is shown in **Figure 11**, which shows that before the earthquake Mw6.9 on May 24, 2014 in Aegean Sea, obvious subcrustal seismic activities sign appeared, there was a set of deep seismic activity in 2009-2010 from underground 656 km straight crust, then it beats in less than 220 km depth, until an earthquake Mw6.9 occurred. Prior to the earthquake Mw6.9 on February 14, 2008, there was no such activity, possibly due to the lack of seismic data before 2005 year.

The deep seismic activity of 2009-2010 years occurred in one year later after the earthquake Mw6.9 in 2008. It is impossible to be caused by the earthquake in 2008. Moreover, there was no similar deep earthquake activity after the earthquake Mw6.9 in 2014 more than one year. So it is certain that the deep seismic activity of this

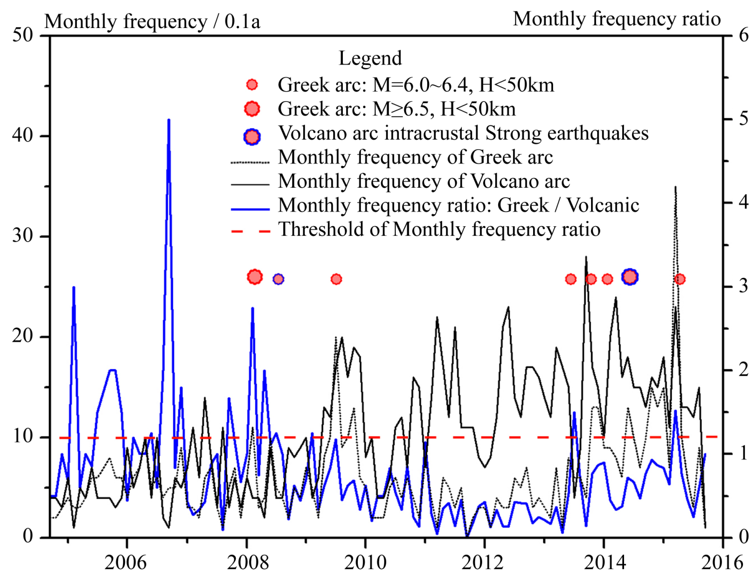

Figure 10. Monthly frequency and its ratio of the subcrustal earthquakes of the Greek arc block and the Volcano arc block in the Aegean Sea Seismic Cone.

Figure 11. Seismic focal depth sequence diagram of the Turkish Branch Seismic Cone (Jan.1, 2005 - Oct.1, 2015, M ≥ 1.5).

group is the precursor of the earthquake Mw6.9 in 2014. This phenomenon deserves further study.

4.2. Seismogenic Process before the Earthquake Mw6.9 on May 24, 2014 in the Aegean Sea

The subcrustal earthquake activity in the Aegean Sea area from January 1, 2009 to October 1, 2015 is shown in **Figure 12**. The figure indicates that seismic activity of the Volcano arc block, which was dense seismic at both ends of the Volcano arc, and the red earthquakes under 500 km depth below constituting a super active layer [5] opening to the northwest, was significantly higher than that of the Greek arc block.

The earthquake focal depth sequence of the Aegean Sea from January 1, 2008 to October 1, 2015 is shown in **Figure 13**. The diagram shows that after deep source earthquake activities of Aegean Sea Seismic Cone since

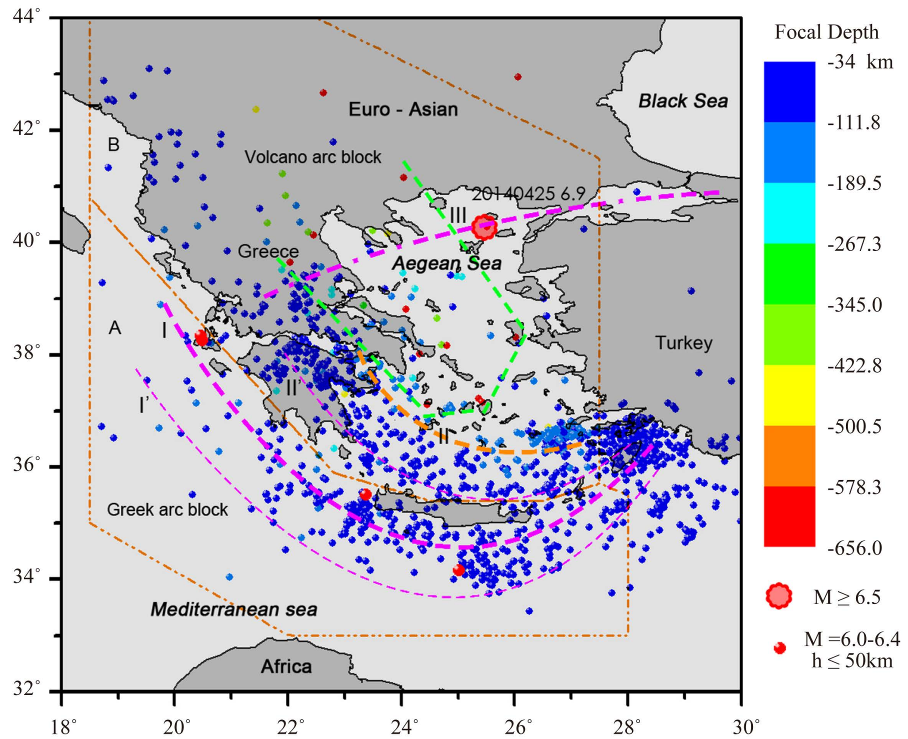

Figure 12. Premonition earthquake distribution of the earthquake Mw6.9 on May 24, 2014 in the northern Aegean Sea (Jan.1, 2009 - Oct. 1, 2015, M ≥ 1.5).

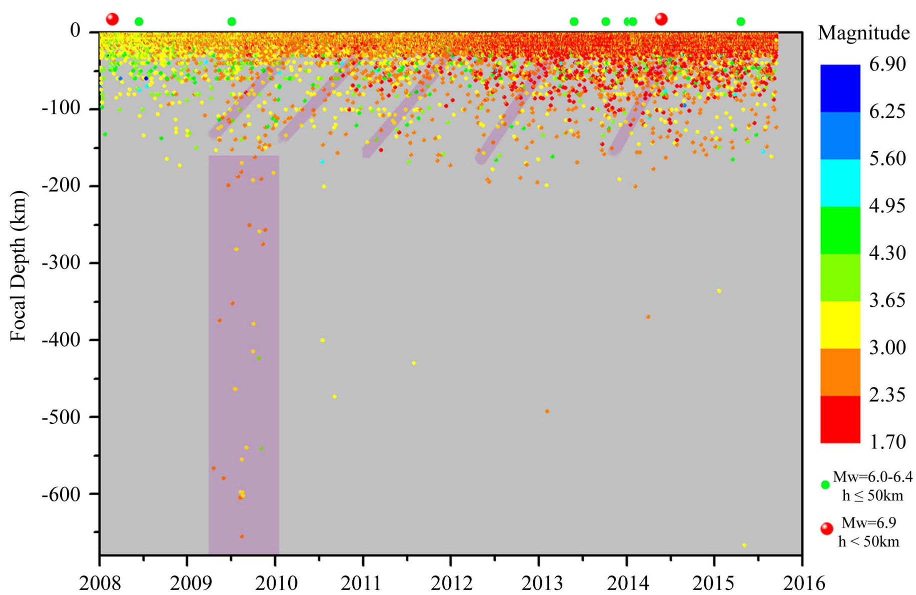

Figure 13. The seismogenic process of the earthquake Mw6.9 on May 24, 2014 in the northern Aegean Sea (Jan.1, 2008 - Oct. 1, 2015, M ≥ 1.7).

2009 there appeared several times of disturbance from bottom to top, fluctuating in the lithosphere within 220 km depth, before and after 2010, 2011, 2013 and before 2014. This was like a stir in the cone body of depth more than 600 kilometers and then caused a series of ripples in the layer close to the ground (lithosphere, within 220 km depth), to accumulate energy and find a breakthrough release place finally, which was the weak part of the North Anatolian Fault. During the period there was also 4 earthquakes 6+ in the Greek arc block but failed to release the energy of the Volcano arc block (**Figure 12** and **Figure 13**). In the image, the process is like a tornado, a storm from the deep mantle to the surface of the Earth.

Figure 14 shows all the seismic sets before the earthquake Mw6.9 from January 1, 2009 to May 24, 2014. Will this picture is decomposed into 0.1a as a frame of the animation to concentrate the earthquake preparation process of more than 5 years upon ten seconds, the situation is more exciting: after the formation of the earthquake pillar of depth more than 600 km in 2009-2010, there appeared a number of jumps in the layer of 220 km depth, until the earthquake occurred (Blog figure 4, gif). Will for **Figure 11**, taking seismic activity in 2008 as background, and then it is made an animation since 2009 and shown a same effect because of no strong earthquakes around 7 in this period in the Aegean sea outside (Blog figure 6, gif).

However, because this animation cannot be accepted in publishing, we ordered the animation in the web of Seisman's Blog in the Sciencenet web as the indispensable.

Link: http://blog.sciencenet.cn/blog-552558-969802.html

A more than 600 km deep seismic activity pillar, stirring within 220 km thick stratum, cause the burst of the weak parts of the crust structure and a strong earthquake. The seismogenic process and seismogenic mechanism of the earthquake Mw6.9 on May 24, 2014 in northern Aegean Sea show that the energy accumulation of a strong earthquake is from deep mantle and it looked for a weak part of the surface structure to break through before the earthquake happened.

5. Discussion and Conclusion

5.1. Discussion and Explanation of Some Problems

In order to improve the conclusion of this paper, we make a discussion and explanation on the following questions.

1) On the repartition of seismic cones of the Turkish Branch Seismic Cone

Figure 7 shows the results of the repartition of the seismic cones of the Turkish Branch Seismic Cone. It is easy to confuse people if we rely on the future data of the Mediterranean seismic network to be verified. At present, at least the Aegean Sea Seismic Cone is determined. The Aegean Sea Seismic Cone is similar to an onion, and the situation is more complex. Preliminary viewed, the Volcano arc block is like an onion heart and the Greek arc block is like an onion skin. In other words, it looks like that the former is wrapped in the latter by **Figure 6** and **Figure 14**. The data processing is difficult to peel. The results in **Figure 10** show two independent activities and their mutual influence and interference. Before the earthquake Mw6.9 in 2014 in the Volcano arc block, monthly frequency ratio is very low. If the monthly frequency ratio is greater than 1, there will be me-

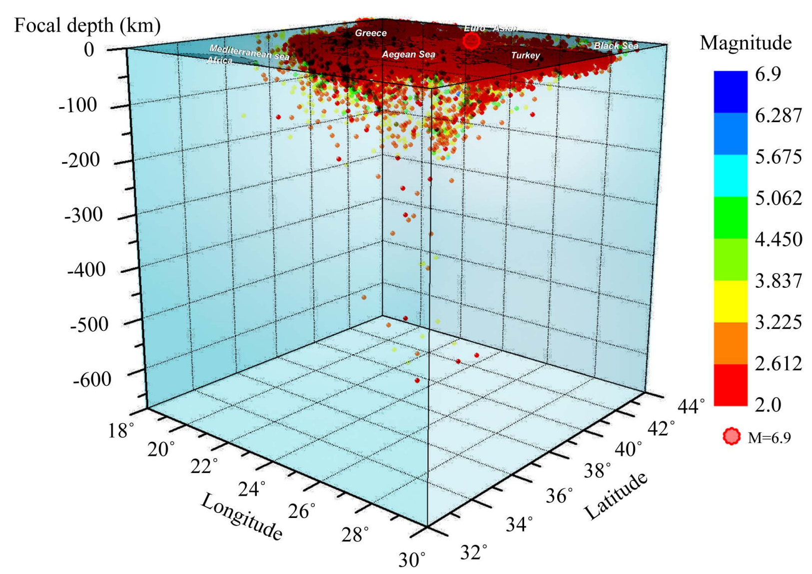

Figure 14. A set of earthquake precursors of the earthquake Mw6.9 on May 24, 2014 in the northern Aegean Sea (Jan.1, 2009 - May 24, 2014, M ≥ 2).

dium strong earthquake activity in the subcrustal seismic dense zone of the Greek arc block. This suggests the complexity of the problem.

Deep seismic data of the Turkish Seismic Cone is not enough. If another earthquake, such as one in 1999, may be changed it. The intracrustal microseismic activity of the Romanian Seismic Cone is few and deep earthquake activity is a lot more, but there were some strong earthquakes in crust that happened suddenly. It is because that the seismic activity mainly in the lithosphere. The earthquake activity in the Polish Seismic Cone has small strength, but it affects the safety of the local mine, which is worth attention.

It is certain that the depth of the 4 three-level seismic cones is more than 600 km, but it is difficult to discuss because of the lack of seismic data.

2) About the energy of seismic cone pillar

Is the total energy of the seismic cone pillar, as show in **Figure 11**, sufficient to drive an earthquake Mw6.9? It is unable to make this estimation now. But one thing is clear: deep seismic activity is a characterization of accumulation and transfer of energy. Just like the boiling water, people can see bubble rise and rupture but not heat convection, conduction, and radiation, which is the most part of the energy. Deep seismic cone pillar is more complicated compared with the boiling water.

3) On seismic tectonic model of the Aegean Sea area

This paper studies 4 three-level seismic cones around the Aegean Sea. It is a simple structural model. But there is a deeper problem, that is, the collected evidence is not enough to determine whether the center of Aegean Sea is counterclockwise rotation of the surface structure or not. The popular tectonics mode in the field of geoscience is splice and collision of several "plates" in the Aegean Sea region. One can make some explanation after an earthquake happened, but it seems very difficult to solve problems of earthquake prediction.

5.2. Conclusion

In accordance with the Seismo-Geothermics theory about methods of intracrustal strong earthquake and volcano prediction, we use the ANSS earthquake catalogue from the Northern California earthquake data center and the EMSC earthquake catalogue from the European-Mediterranean Seismological Centre to study the seismic activities of the Turkish Branch Cone in the Mediterranean Seismic Cone and the following Aegean Sea Seismic Cone, and show reproduction through graphics and animation, the seismogenic process and seismogenic mechanism of the earthquake Mw6.9 on May 24, 2014 in northern Aegean Sea. It was concluded that the energy of strong earthquake of magnitude around 7 in Aegean Sea was probably from energy transfer and accumulation in deep mantle and incentive lithosphere in the way of wave pattern. Then the strong earthquake occurred suddenly in search of the weak parts of the surface structure. This is a perfect example of that intracrustal strong earthquake is being predicted.

The purpose of this paper is to open a hole in the traditional seismic genesis, and it is beneficial to the further research on the theory and method of earthquake prediction. It is our first attempt to study this case and it needs further examination. In this paper, we divide the Turkish Branch Seismic Cone of the Mediterranean Seismic Cone into 4 tertiary seismic cones, and we show a preliminary seismo-tectonic model of Aegean region. It will be conducive to seismic monitoring and earthquake prediction research in Greece, Turkey, Romania and Poland regions. Due to the high quality earthquake catalogue in these areas, as long as according to the pattern structure of the **Figure 7** to change the thinking of the earthquake prediction, outlook is optimistic.

The result of this paper is very difficult to achieve in other areas, because there are only ideal microseismicity data of the Mediterranean Sea and the North America data in author's hand. By contrast, seismic data in China are rich but have poor precision of the focal depth in some regions, which calls for constant improvement. However, the author believes that this strong seismogenic model found in Aegean Sea region could proceed from one point to another. In some other areas of high seismic activity, such as Chile, Philippines, Tonga, Indonesia, Japan, and America, it may provide more examples by using the ANSS earthquake catalog or local high quality earthquake catalogues [48] [49]. At present, the world's earthquake prediction has little effect, and it even tends to be not cognitive. Innovative thinking is the only way out.

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