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THE PREDICATION FOR THE DATE OF THE OCCURRENCE OF LARGE EARTHQUAKES —THE MULTIPLIED NINE-DAY REGULARITY IN DIFFERENT YEARS

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So far there has not been any good way to make a prediction for the date of the occurrence of large earthquakes. Therefore it is necessary to have a research on it from every aspect. Even if the study result is only of a little value for reference, it is worth making a research on it. On the basis of the multiplied nine-day regularity put forward by us, in 1977[1—9] this paper raises the multiplied nine-day regularity in different years. The multiplied nine-day regularity we put forward before is the continuous sequence one, but now in this paper it is the multiplied nine-day regularity of discontinuous sequence, which is refered to the prediction for the date of the large earthquakes ($M \geqslant 7$) occurrence.

1. A brief introduction to the prediction for the date of the occurrence of earthquakes by means of the multiplied nine-day regularity

In the light of our previous study, the formula which is used to predict earthquakes by means of the multiplied nine-day regularity is:

$$T_E = T_O + nt \pm \sigma \qquad (1)$$

$$n = 0, 1, 2, \cdots\cdots$$

In the formula T_E is the date of the occurrence of earthquake, which has been predicted; T_O is the starting date for prediction; t is the commensurable time and σ is error. T_O can come from the different starting index. They are: the date of the occurrence of magnetic storm ($K \geqslant 6$); the date of appearance of spike-like precursors; the date of the synchronization of spike-like precursors and external factors; the date of the appearance of foreshock (including those earthquakes with the precursory migration).

In the formula (1), t, the commensurable time, can be the follow-

ing values:

If the precursors (including seismometry index) are synchronized with magnetic storm ($K \geqslant 6$), t = 9 days, a better value;

If the starting time is only from magnetic-storm date, t = 9 days, a better value;

If the precursors (including seismometry index) are synchronized with syzygy, t = 7 days, a better value;

If the spike-like precursros (including seismometry index) are not companied with external causes, that is better for t to be equal to nine days.

As for the intervals of large earthquakes' migration, t is also taken as nine days.

2. The multiplied nine-day regularity in different years

This regularity refers to the multiplied nine-day phenomenon in the day sequence for the earthquakes in different years. According to the statistic data, in China this phenomenon seems to be more obvious for $M \geqslant 7$ earthquakes. Some examples are taken in the following:

1) The seismic zone of the piedmont of Yanshan Mountains and Bohai Sea region

In the regions of Yanshan Mountains and Bohai Sea, there were only four large earthquakes ($M \geqslant 7.0$) to have occurred in history (Fig. 1). Those in the piedmont of Yanshan Mountains are: a large earthquake ($M = 7.8$) on Sept. 2, 1679 in Pinggu, Sanhe; and another large earthquake ($M = 7.8$) on July 28, 1976, in Tangshan. Those in the region of Bohai Sea are: an earthquake ($M = 7.5$) on June 13, 1888, and an earthquake ($M = 7.4$) on July 18, 1969. Though the four earthquakes occurred in different years, yet their day sequences of the months tally with the multiplied nine-day regularity. Without taking count of the year difference, the day difference of the two large earthquakes' occurrence in the piedmont of Yanshan Mountains is 36 days, and 35 days for the two large earthquakes in Bohai Sea region, as is shown in Fig. 2. From this figure, the Tangshan earthquake is in the common multiplied nine-day date for both the Sanhe earthquake in 1679 and the Bahai earthquakes in 1888 and 1969.

2) The seismic zone from Maowen to Wudu.

In this region three earthquakes ($M \geqslant 7$) historically occurred, they are: earthquake ($M = 7\frac{1}{2}$) on July 1, 1879 in Wenxian county, Wudu prefecture; earthquake ($M = 7\frac{1}{2}$) on Aug. 25, 1933 in Diexi; and Songpan earthquake ($M = 7.2$) on Aug. 16, 1976 (in fact, Songpan large earth-

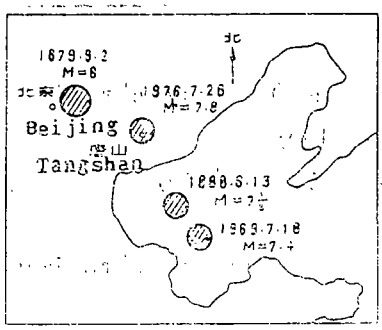

图1 燕山南麓地震带和渤海地区四次7级以上地震

Fig. 1 The four earthquakes (M= 7～8) in the seismic zone of Yanshan Mountains' piedmont and Bohai Sea region

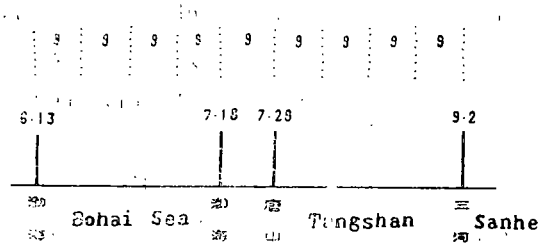

图2 燕山南麓地震带和渤海地区四次地震的间隔日期

Fig. 2 The date intervals of the four earthquakes in the seismic zone of the piedmont of Yanshan Mountains and Bohai Sea region

quake has twice, but it may be regarded as once.). The epicenters of the three large earthquakes are shown in Fig. 3. If the year differences of the occurrence of the large earthquakes are not considered here, the day difference of the earthquakes' occurrence are: The day difference between the earthquake in Wenxian county and that in Diexi is 55 days, and that in Songpan is 46 days. The day difference between Songpan earthquake and Diexi earthquake is 9 days. That is to say that Songpan earthquake with M=7.2 in 1976 occurred in the common multiplied nine-day date for both Wudu earthquake in 1879 and Diexi large earthquake in 1933.

3) The seismic zone from Motuo to Milin

There were also two large earthquakes (M≥7.5) to have occurred in this region (Fig. 4). One of them, M=7¾, in the South of Milin, Langxian

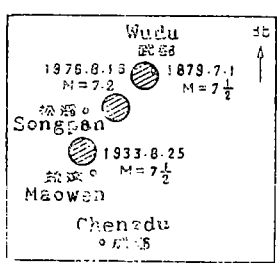

图3 武都—茂汶地区3次大于7级的地震

Fig. 3 The three earthquakes (M>7) in the Wudu-Maowen seismic zone

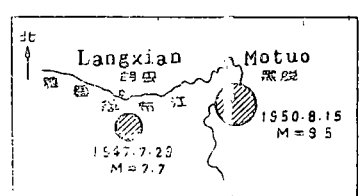

图4 西藏墨脱二次大地震 (M>7.5)

Fig. 4 The two historical large earthquakes(M>7.5) in Motuo, Xizang

County, another earthquake (M=8.5) near Motuo. The occurrence dates of the two large earthquakes respectively are: July 29, 1947 and Aug. 15, 1950. Not to take count of the year difference, the day diffreence is 17 days.

4) The seismic zone from Dangxiong to Qilin Lake

The seismic zone is EW direction in which there were two large earthquakes (M≥7) in history, as is shown in Fig. 5 . They are: an earthquake (M= 7) on Dec.15, 1934 in Shenzha, and another (M=8.0) on Nov.18, 1951 in Dangxiong. Without considering the year difference, the day difference of the two large earthquakes is 27 days.

5) The seismic zone from Daofu to Luhuo

This seismic zone historically had two large earthquakes (M≥7) which are: Daofu large earthquake (M= 7 ¼) on May. 24, 1923 and Luhuo large earthquake (M=7.5) on Feb. 6, 1973, as is shown in Fig. 6 . Not to take count of the year difference for the two earthquakes, the day difference of the occurrence of the two earthquakes is 46 days.

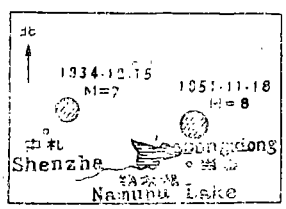

图 5　当雄—申扎地区 7 级以上大震

Fig. 5 The large earthquake (M≥7) in Dangxiong—Shenzha region.

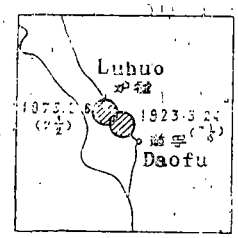

图 6　道孚—炉霍地区 7 级以上大震

Fig. 6 The large earthquakes (M≥7) in Daofu—Luhuo region.

6) The region from Dongchuan to Songming, yuannan province

This region had two large earthquakes (M>7) in the past, which is shown in Fig. 7 . One of the earthquakes (M=7.5) is on Aug. 2, 1733 in Dongchuan, and another earthquake (M=8) is on Sept. 6, 1833 in Songming. Without the year difference to be considered, the day difference is 35 days.

7) The region from Tancheng to Weifang, Shandong province

Two large earthquakes (M≥7) once hit this region historically, one of which is the earthquake (M= 7) on June 1, 70 B.C. and the other is the earthquake (M=8.5) on July 25, 1668 (Fig. 8). Not to consider the year difference, the day difference between the two earthquakes' occurreete is 54 days.

8) The region of Balikun, Xinjiang

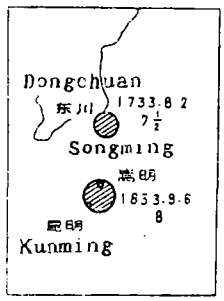

图7 云南省东川—嵩明地区
7级以上大震

Fig. 7 The large earthquakes (M≥7) in Dongchuan-Songming region, Yuannan Province

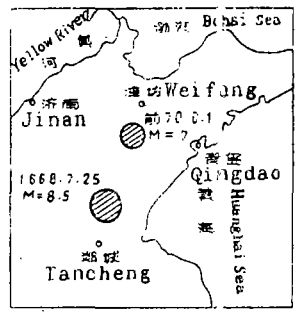

图8 郯城—潍坊地区
7级以上大震

Fig. 8 The large earthquakes (M≥7) in Tancheng-Weifang region, Shandong province

In history two earthqakes (M>7) once hit this region, which are: an earthquake (M=7½) on June 11, 1842, and an earthquake (M=7½) on Aug. 5, 1914 (Fig.9). The interval between them is 55 days.

9) The region of Wuqia, Xinjiang

Many earthquakes (M>7) once occurred in this region, which is shown in Fig.10. It is interesting that the day interval between the large earthquakes in 1902 and in 1944 is 37 days, on whose common multiplied nine-day date there occurred a large earthquake on Aug.23, 1985, which happened to be on the date 36 days ago of 1944 large earthquake and on the second day of the date of 1902 large earthquake (zero multiplied nine day).

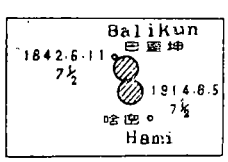

图9 新疆巴里坤—哈密地区
两次7½级地震

Fig. 9 Two large earthquakes (M=7½) in Balikun—Hami region, Xinjiang

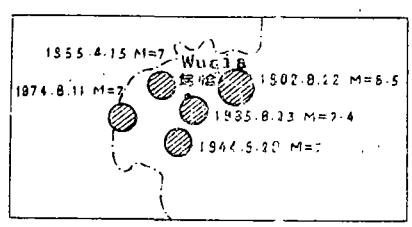

图10 新疆乌恰地区7级
以上大7½震

Fig.10 The large earthquakes (M≥7) in Wuqia region, Xinjiang

10) The region of Aertai, Xinjiang

Two earthquakes (M>7) once were in this region. They are: Fuyun earthquake (M=8) on Aug.11, 1931, and another earthqnake (M=7.1) on

July 5,1974, near the boundary line, which have 37 days as the interval, as is shown in Fig.11.

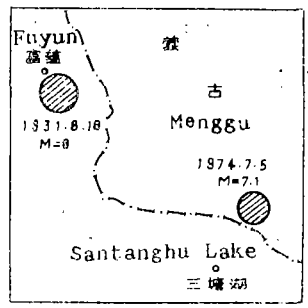

图11　新疆阿尔泰地区7级以上大震

Fig.11　The large earthquakes (M≥7) in Aertai region, Xinjiang

3.To predict the date of the occurrence of large earthquakes by means of the multiplied nine—day regularity in different years

From the above—mentioned examples, the multiplied nine—day regularity in different years is more common, so it is of a certain of significance on the problem of the prediction of the occurrence date of large earthquakes.

When the concrete prediction is made, if in some months and in some regiongs the precursors are found, the dates of the occurrence of the predicted dates of the occurrence of large earthquakes. In detail, the dates of the occurrence of the historical earthquakes are the starting dates, and from them, the multiplied nine days may be conducted, but it should be pointed out that when the dates of the occurrence of the historical large earthquakes are used to multiply nine days, both the future dates and the past dates can be taken as the dates of the multiplied nine days. Thus, for the multiplied nine—day regularity in different years, a minus must be added to the formula (1), i.e.

$$T_E = T_0 \pm nt \pm \sigma \qquad \cdots\cdots (2)$$

where T_0 is the date of the occurrence of the historical large earthquakes; "+" stands for the future date to be multiplied with nine days and "−" for the past date to be multiplied with nine days.

Suppose that there are N days in the months which earthquakes are in, among N days, there are n days of the multiplied nine days, the probability of the dates of the multiplied nine days which an earthquake

occasionally happen to is

$$P=\frac{n(1+2\sigma)}{N} \qquad (3)$$

In practice, if all the dates of occurrence of large earthquakes in the same region tally with the dates multiplied by nine days, the value, which transcends the accidental probability, is

$$H=1-\frac{n(1+2\sigma)}{N} \qquad (4)$$

When H is higher than $\frac{1}{3}$, it means that the multiplied nine-day regularity does not happen to have that occasionally.

Let $\sigma=1$ day, the formula (3) may be changed as

$$P\approx\frac{1}{3} \qquad (5)$$

This formula means that among N, days there are ⅓ of the days to come across the dates of the multipled nine days.

As for the region of Yanshan Mountains—Bohai Sea, the dates of the occurrence of the four large earthquakes tally with the dates of the multiplied nine days. That is:

$$H\approx\frac{2}{3} \qquad (6)$$

This makes it clear that it is not occasional for the dates of the occurrence of the earthquakes in Yanshan Mountains-Bohai Sea region to conform to the dates of the multiplied nine days.

In order to have a reference in the prediction of earthquakes afterwards, a zonation map is made by us, which is about those regions where the dates of the occurrence of the large earthquakes ($M\geq 7$) all over the country tally with the multiplied nine-day regularity, shown in Fig.12.

图12 中国境内符合倍九日期的7级以上大震分布区

Fig.12 The distribution of the regions where once occurred the large earthquakes ($M\geq 7$) which conform to the multiplied nine days in China

From the above maps, two points can be obtained:

1) The region where the dates of the occurrence of large earthquakes tally with the multiplied nine days are not very dispersed. They concentrate themselves on Yaushan Mountains, Bohai Sea, Tancheng, Songpan and Yunhan-Sicnuan and regions of waqia, Aertai, Balikun in Xinjang. There is no obvious dates of the multiplied nine—day regularity in the zone of Fenshui River and Weihe River.

2) The prior season for the dates of the occurrence of the large earthquakes which conform to the dates of the multiplied nine days is from June to Septemper.

When the earthquake prediction is made in practice, precursors also can be used to calculate the dates of the occurrence of the earthquakes (no conclusion, certainly, so far, only study on it). If compared with the dates of the occurrence of earthquakes calculated by precursors and the dates of the earthquake occurrence obtained from the multiplied nine-day regularity in different years, the coincident dates may be taken as the most possible dates of the occurrence of the large earthquakes, and thus there is a higher accuracy rate. Before Tangshan earthquake in 1976, there ere many precursors to appear, and it was estimated that there would be an earthquake to occur, but it could not tell what date to have. If the multiplied nine-day regularity in different years had been considered, it would have been possible for the date of the occurrence of this large earthquake to be told, at least as a reference date.

In the end, it should be pointed out that there are more events of the multiplied nine-day regularity in different years, it shows us that the cause of this regularity is not occasional. We think that the large earthqakes have the intervals of a few decade years and a few hundred years, the months of the occurrence of these large earthquakes are much close and their intervals are conformed to the multiplied nine-day regularity in different years, which seems to be the result of the modulation of external causes. Meanwhile the multiplied nine-day regularity in different years has such a clear priority that there is a controlling role in the dates of the occurrence of the large earthquakes from an exteranl cause. But what kind of external cause plays this important modulating role is still a problem to be discussed afterwards.

Baside, we should study the way to go to chaos. we found there is a simple relation betwene the two universal numbers. A, B of two kinds of things and the golden section number C as follows

$$2A-B=C$$

where $A=4.66920$, $B=8.7210$, $C=0.618$. It is worth studying the relation in practice.

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大震发生日期的预报——异年倍九律

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摘　要

本文在1977年以来提出的“予报地震的倍九律”基础上，研究了我国很多地震区大震的异年倍九现象，进一步提出了“异年倍九律”。异年倍九律是指相近地区不同年份大震发震日序间具有倍九日关系的情况。由于大震日期予报至为重要，所以本文仅以7级和7级以上大震进行统计。统计发现我国许多地震区大地震发生日期符合上述异年倍九律现象。这些地区是渤海至燕山前麓地震区，山东郯城潍坊地震区，武都茂汶地震区，四川巴塘、理塘地震区，炉霍、道孚地震区，云南东川、嵩明地震区，西藏墨脱至米林地震带，当雄至奇林湖地震区，新疆巴里坤地震区，乌恰地震区和富蕴至中蒙边境阿尔泰地震带。由这十一个地区异年倍九的震例来看，地震日序差值以36天的频次最高，约占总的统计数40%，月份大多出现在6—9月。此外符合这种时间规律的地区不是杂乱的，例如汾渭地震带就不符合这种规律。因此异年倍九律对某些已有短期震兆的地震危险区发布大震的发震日期有一定参考作用。

异年地震发震日期的倍九律具有较多的统计事实表明，这种现象的出现不是偶然的。作者认为相差几十年和几百年的大震，它们发震的月份相近，且发生地震的日期符合倍九律可能与这些地区在这段时期具有倍九时间特征的外因较强有关。也即与外因对地震的调制作用有关。具体的调制因素和调制机制尚需进一步研究。初步认为可能是气象因素、磁暴，日月引力等外因因素对地震的发生起到了调制作用，以上这三种外因均有倍九天的周期成份，如这三种倍九天的周期成份在某些地区某些时间产生合拍运动，则就可能增加外因对地震的作用。

在自然界除了研究可公度性和周期性现象外，还要研究走向混沌的道路。我们发现，两大类事物分别走向混沌的临界常数A和B，与黄金分割数C之间有一简单关系，即：

$$2A - B = C$$

式中　$A = 4.66920$，$B = 8.7210$，$C = 0.618$（此亦为优选法中的常数）。