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EPICENTRAL MIGRATION AND PRECURSORY ACUPOINTS

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In the past two decade years, the earthquake prediction test has been widely practised in China not only among her experts but among her publics, who have experienced at both some spots with obvious precursors even the spot is very far from epicenter, and others with equivocal ones.The spots with obvious precursors are naturally likened to acupuncture points in view of the reason that the famous medicine therapeutics---acupuncture points, rises in China.But its crux has not been made out.This paper intends to deal with the far precursory acupoints out of epicentral migration.

I.Hypothesis and basic viewpoint

In 1966, we pointed out that earthquake migration and its repetition is useful for earthquake prediction(1).In 1971,1973,1977 and 1985, we discussed the mechanism of earthquake migration(1)(2)(3)(4)

Based on previous studies, we generalize the earthquake migration as the tectonic event migration.

These tectonic events have different velocity.The fast event is responsible to earthguake.The sub-fast tectonic event is responsible to direct precursors and indirect precursors.In this case, we divide the tectonic event migrations into three kinds:

1.Fast event(earthquake)→Fast event(earthquake)

2.Sub-fast event(Precursor)→Fast event(earthquake)

3.Fast event(earthquake)→Sub fast event(after effect)

According to the above.mentioned, we generalize the earthquake migration repetition as the above three tectonic event repetitions.

In the earthquake prediction practice, we should make the track map of the historical earthquake migrations and find the starting point of earthquake migration.If we found some of precursors to appear in the starting point, we may predict a strong earthquake will possibly occur in the surrounding of this point or in that place, where there had been a strong earthquake to follow the starting earthquake in history. We regard the starting point of the earthquake migration as a precursory acupoint.

Besides, the initial area of an earthquake episode is a possible precursory acupoint, which is responsible to the following earthquakes of the episode.

II. The starting-point of epicentral migration and precursory acupoints

The epicentral migration is an index reflecting the motion relation between the different localities of interior of the earth. Therefore the starting point and initial area should be the acupoint district of precursors. We call such an acupoint "the acupoint of earthquake migration". Here are some events to exemplify it.

1. The acupoint of earthquake migration in Kangding

We once pointed out in 1977 that Kangding region is a starting spot of epicentral migrations[8]. Take the following events for examples: After M=6.0 earthquake on Apr.28 1935 in the southeast of Kangding, only seven months later there were four strong earthquakes with magnitude of 6-6.7 to follow it in Mabian region, south east 150-200km away from Kang ding. Since June 12, 1941 earthquake of M=6.0 in the east of Kangding, the four months were nearly over but another earthquake with M=6.0 followed it in Heishui, northwest and 200 Km away from Kangding. Another instance is that on Apr, 14, 1955 Kangding was hit again by an earthquake with M=7.5. Only two to five months later in the same year, Huaping and Yongren, in the south and 350 Km away from Kangding ran up against earthquakes of M=6.0 (June. 7) and $M=6\frac{3}{4}$ (Sept. 23) respectively (Fig. 1).

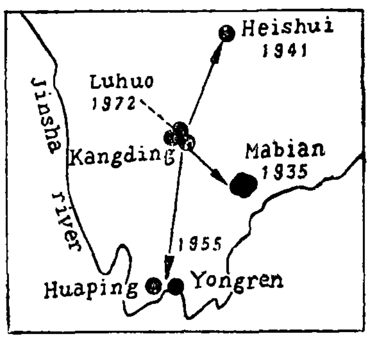

Fig. 1 The epicentral migration taking Kangding as its starting spot.

Besides, after the earthquake of M=5.2, on Apr. 8, 1972, in the southwest of Kangding, twice events a day in Luohuo in the same year, with

M=4.4 and 4.5 respectively, which can be considered as a short-term migration of moderate earthquakes.

It interests us very much that in the following time, strong earthquakes took place again in Luohuo in 1973, in Mabian in 1973 and in Songpan in 1976 respectively, and 6-8 days before them, a sharp anomaly of radon content in ground water appeared in Kangding region, as shown in Fig. 2.

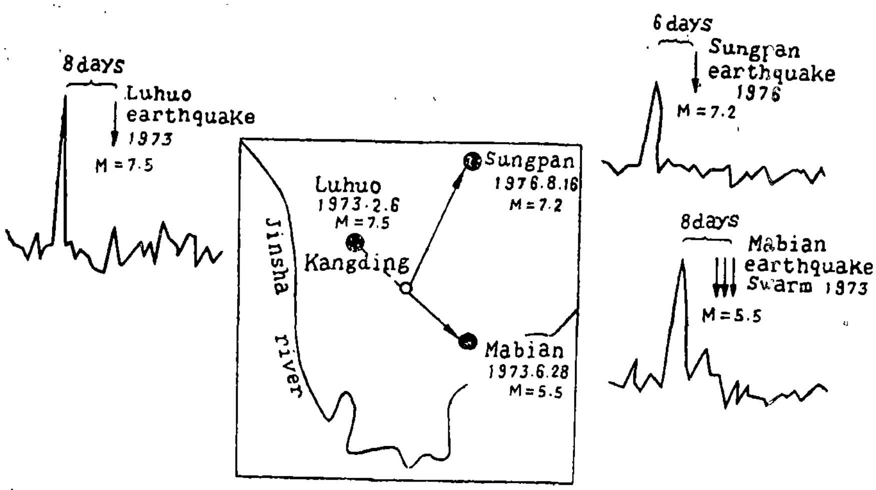

Fig. 2 The radon anomalies recorded in Guza station, Kangding, before Mabian, Songpan and Luhuo earthquakes

There exists a relation between epicentral migration and precursory acupoints, which comes from the comparison between Fig 1 and Fig 2. But at present great earthquakes haven't come to Huaping and Yongren, south to Kangding. Inferred from the above relation, the precursory acupoint in Kangding can monitor the coming events in the Huaping-Yongren region.

2. The acupoint of earthquake migration in Jinxian County

In historical record destructive earthquake in Liaoning Province was rare. After events in Jinxian County, one with M=5$\frac{1}{2}$, on Dec.11,1855 and another with M=5$\frac{1}{4}$, on Apr.10,1856, three years and four months had flown, i, e, on Sept, 19, 1859, a M=5.0 earthquake occurred in Yingkou, as is shown in Fig. 3. It is more interesting to us that before the 1975 Haicheng-Yingkuo earthquake of M=7.3, the short-levelling abnomality was predominant in middle term and a sudden change of radon appeared near to shock. (Fig. 4) On the right of the Figure was placed the anomalous curve of radon and short level.

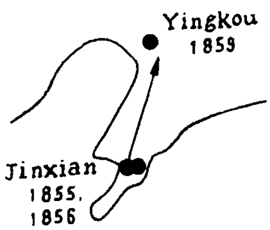

Fig. 3 The epicentral migration from Jinxian County to Yingkou.

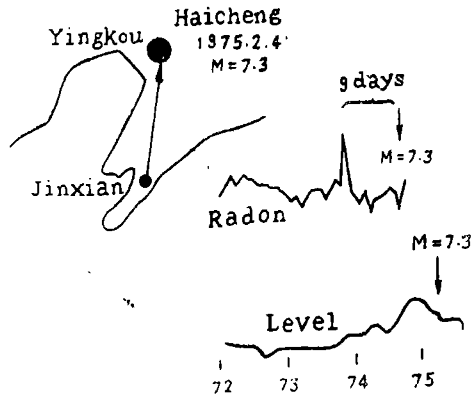

Fig. 4 The level and radon precursors before Haicheng earthquake. in Jinxian County

3: Precursor acupoints in Xingtai and Changdokou.

In history there were twice destructive earthquake migrations from Xingtai region to Tangshan region as shown in Fig. 5.

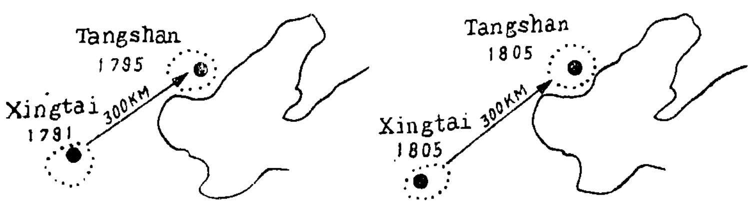

Fig. 5 Earthquake migration from Xingtai region to Tangshan region in history

It is interesting that 8 days before the 1976 Tangshan earthquake (M= 7.8), a sudden anomaly of radon content in underground water appeared in Xingtai region (Fig. 6).

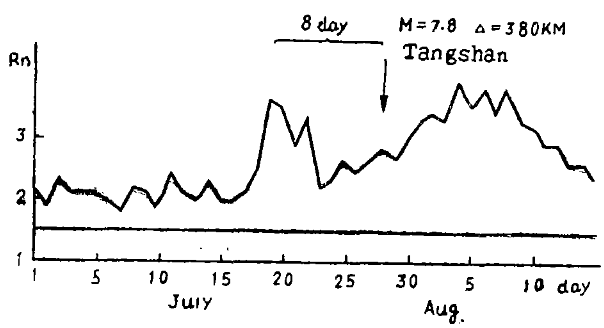

Fig. 6 Radon anomaly in Xingtai before the Tangshan earthquake (M=7.8)

Besides, there was earthquake migration (M⩾5) from the surrounding of Changdokou to Tangshan region in 1621-1624,as shown in Fig. 7. About 6-7 days before great Tangshan earthquake on July 28, 1967,a sharp anomaly of radon appeared in Changdokou station,as seen in Fig. 8.

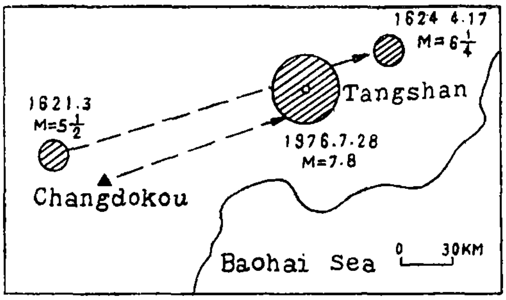

Fig. 7 Earthquake migration from the surrounding of Chang dokou to Tangshan region in history

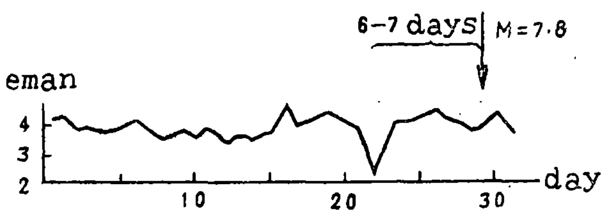

Fig. 8 Radon anomaly in Changdokou before the 1976 Tangshan earthquake

4.Precursor acupoint in Liyang

In 1974,an earthquake with magnitude of 5.5 took place in Liyang County. One year later,in 1975,another earthquake (M=5.2) happened in South-Yellow Sea,as shown in Fig. 9.This is the earthquake migration in the past. In 1984, radon anomaly appeared in Liyang station, about 19 days later, M=6.2 earthquake hit South Yellow Sea,as seen in Fig.10.

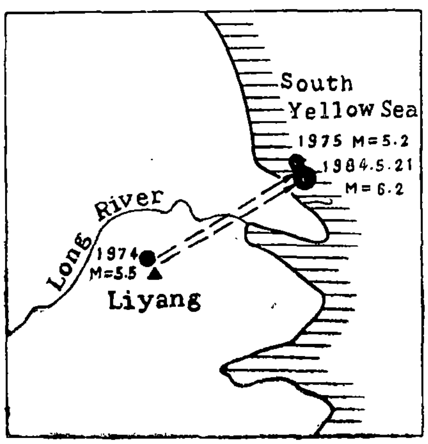

Fig. 9 Earthquake migration from liyang to the South Yellow sea.

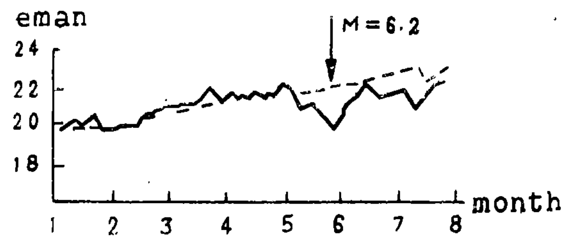

Fig.10 Radon anomaly in Liyang station before the 1984 South Yellow Sea earthquake (M=6.2).

Ⅱ. Mechanism of the earthquake migration acupoint

Earthquake migration with long distance may be explained by the stereographic cross model, as shown in Fig.11. In this figure an earthquake occurs in the spot A, then another earthquake follows it in the spot B. It is so called earthquake migration. Earthquakes in A and B are connected by the creep fault propagation in lower lithosphere. The earthquake in A can trigger the creep faulting propagation. The triggering mechanism is described as follows. If fault A in upper lithosphere approaches unstable state, according to the modulation model[5], some external factors (as tidal force, magnetic storm and so on) may trigger it and produce creep slipping or inelastic deformation, and induce many precursors. At the same time, the creep faulting in upper lithosphere can trigger the propagation of creep faulting in lower lithosphere. This creep faulting propagation may promote fault B in upper lithosphere to generate earthpuake. The triggering mechanism is Shown in Fig.12 and Fig.13.

Fig.12 describes the triggering mechanism of strike slipping in upper lithosphere on the creep faulting propagation in lower lithosphere. Fig.13 describes the triggering mechanism of thrust slipping in upper lithosphere on the creep faulting propagation in lower lithosphere.

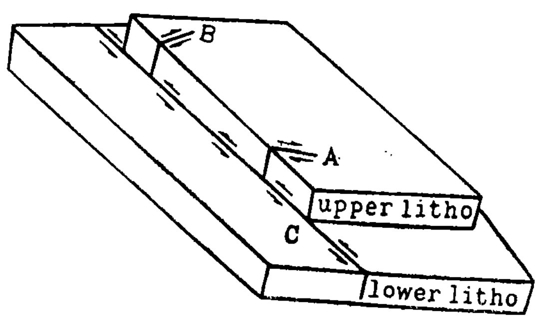

Fig.11 Earthquake migration expressed by the stereographic cross model.

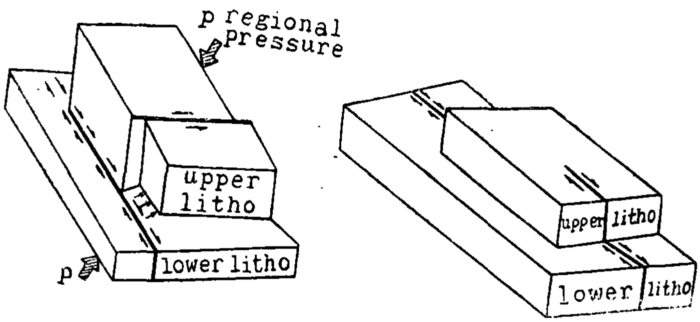

Fig.12 Influence of strike slip in upper lithopsphere on creep slip in lower lithosphere.

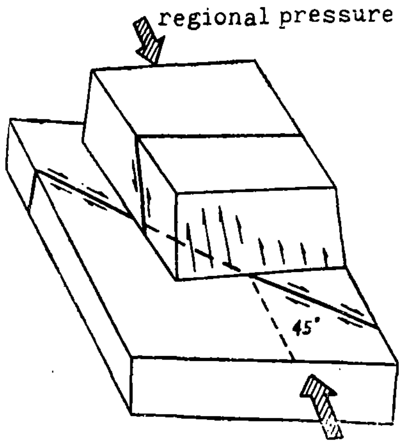

Fig.13 Influene of thrust slipping in upper lithosphere on creep faulting propagation in lower lithosphere.

The triggering action in Fig.12 depends on the tensile stress caused by the movement of fault block in upper lithosphere. The triggering action in Fig.13 depends on the different dislocation amplitude of the thrust slipping.

We call the place A "easily modulated acupoint" which is the same as "earthquake migration acupoint". In this case, we may predict the earthquake occurrence date in spot B by means of the following formula:

$$T = T_0 + nt + \sigma \quad (1)$$

$$n = 0, 1, 2,$$

where T is earthquake occurrence date; T_0 is the modulation day or the syncronization day; t is the commensurability duration; σ is error. According to the modulation model, t = 9 days when precursor is synchronized with magnetic storm, t = 7 days when precursor is synchronized with full moon or new noon. In that case there is only precursor date with-out external factors.

According to statistics, the deviation of the position of forthcoming earthquake from migrated earthquake in history is shown in the following:

$$D \approx 60\text{km} \quad (2)$$

What is mentioned above is a kind of method of earthquake prediction on the basis of precursors and the migration of historical earthquakes. This is one of the programs of earthquake prediction. The other program about prediction is that earthquake may occur around precursor stations. In this case, the occurrence time of earthquake can still be predicted by the modulation formula. The magnitude of forthcoming earthquake can be predicted by the relation between precursor extension radius R and magnitude M. From our combination model, the author and Qin Baoyan have obtained the following formula:

$$R = \frac{1}{2}\left(10^{0.52-1.25} + 10^{0.48-1.57}\right)$$

when the approximation value is taken, the formula is:

$$\log R = 0.5M - 1.4$$

where R is measured by km. Taking the defferent values of R, we can get the corresponding M.

Ⅳ. Discussion

The subject of precursory acupoints is under way both in China and in Japan. Dr Toshihiro Kakimi pointed out in 1982 that it is a common subject for geologists, geophysicists and geochemists to make a search for the precursory acupoints. It seems that the seismologists in China and Japan have the similiar ideas to lead earthquake prediction to practicality. The substance of acupoint theory has just started its research, we hold that the following acupoints possible are worth studying.

1. The acupoint of tectonic junction This acupoint is located on the juncture between large fractures and on the juncture in which a few blocks converged.

2. The acupoint of reservoir percolating water In reservoir water penetrates into underground and such a reservoir region is sensitive to adjustment. Thus it is likely to be a precursory acupoint. One of the examples about this is the earthquake swarm of Shenwo Reservoir before the 1975 Haicheng earthquake with magnitude of 7.3.

3. The acupoint of after earthquakes. The Pleistoseismic area of earthquakes can become the precursory acupoint since it is a adjustment element with being plastic and smashed medium.

4. The acupoints of strongly vertical movement. The vertical motion dominates over the region so that the horizontal stress may be induced in

its periphery, which can relate to seismicity. Therefore, such a spot can be regarded as an acupoint.

5. The acupoints of favourate sites. There are some soft materials and a certain of instabilility (such as unstable fluid, thermal state, etc.) in some subtewanean sites, so the underground weak signals are always enlarged. This kind of spot may be precursory acupoint, too.

Both experts and amateurs from publics can make a research on the acupoint theory. The author believes that the policy of integrating professionals with amateurs among publics in China will play a more important role in the forecast of great earthquakes.

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震中迁移与前兆穴位

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摘 要

1985年5月，在昆明举行了西南地震工作二十周年纪念大会。作者在会上宣读了震中迁移与前兆穴位的论文。本文就是在这篇论文的基础上写出的。

我们发现在过去震中迁移的始发点上的前兆手段一旦观测到短临异常，则台址附近有震或历史上震中迁移所至之处有震（误差约60公里）。另外过去地震幕的开幕点上的前兆也具有类似的情况。我们称震中迁移始发点为震迁穴，称开幕点为开幕穴。

为了理解上述现象，我们可把震中迁移广义化为构造事件的迁移。这种构造事件速度快者为地震，次快者不发射地震波，但可引起其他前兆。据此可把甲地向乙地的构造事件迁移分为以下三种情况。

1.快速事件（地震）→快速事件（地震）

2.次快速事件（前兆）→快速事件（地震）

3.地震（快速事件）→次快速事件（后效）

如果一个迁移带上已表现过第一种情况，则第二和第三种情况也可能表现。其中第二种情况具有前兆定向预报的意义，是本文讨论的重点。

对于震迁穴上的前兆为什么属于短临前兆的问题，我们可用立交模式和调制模式相结合来解释。从调制模式的角度来看，地震迁移始发点和开幕点一旦呈现后，若历时又不很长，则它们是容易被调制的地点（简称易调点）。易调点被外因调制后可触发下岩石圈中的蠕滑断层传播，从而引起其他地段的大震发生。

我们认为前兆穴位可分两种：一种为静态穴位，如由构造条件和台址条件决定的穴位；另一种是动态穴位，如由地震活动图象决定的穴位。本文还提出了构交穴、库渗穴、震后穴、垂烈穴和址良穴等。这些都需要进一步研究。

以上讨论的是用前兆资料结合历史上震中迁移资料预报地震的方法。这只是预报方案之一。另一方案是前兆观测点附近有震，其发震日期仍按调制公式计算，其震级可按前兆范围半径R与震级M的关系式计算。从组合模式出发，作者和秦保燕得出以下公式：

$$R = \frac{1}{2}\left(10^{0.62-1.25} + 10^{0.48-1.57}\right)$$

若取近似式，则为：

$$\log R = 0.5M - 1.4$$

式中R以公里为单位。如用单台前兆资料，则不同的R相应不同的震级。