THE BEHAVIOUR OF SOME PRECURSORS BEFORE SOME STRONG EARTHQUAKES OCCURRED IN ALBANIA AND SURROUNDING AREAS

ARNAVUTLUK VE ÇEVRESİNDE
BAZI BÜYÜK DEPREMLERDEN ÖNCE GÖRÜLEN BELİRTİLER

Veronika Peçi *

ABSTRACT

Based on the historical and instrumental data, we shall describe an attempt related to the earthquake April 15, 1979 M_L=7.2 in accordance with the seismic gap concept as second kind.

"b" coefficient variation according to Gutenberg-Richter's formula are presented for the period before some moderate earthquakes of Albania as the earthquake of November 16, 1982, M_L=5.5 (in the Central and Western part) and January 9, 1988, M_L=5.4 (in Tirana region). The variations of "b" coefficient are very significant before each event.

The alternation of Vp/Vs changes before and after the earthquake April 15, 1979 are shown for 245 foreshocks and aftershocks.

The identification of this anomaly before these strong earthquakes fit well with the studies of other authors for precursors before the earthquake of April 15, 1979 including the change of the Radon contents as well.

1. SEISMICITY QUIESCENCE AS A PRECURSORS PATTERNS

As known, earthquake prediction remain still a very difficult problem for complicated processes are related to this phenomena. But, the seismicity patterns and related observations are ones among many precursors for strong earthquakes.

Based on the historical and instrumental data for the period 1901 - 1970, M>5.0 (Balkan Map) and 1971-1978, M>4.0 of the area 41^{o}-43^{o}N, 18^{o}-21^{o}E (see fig. 1.a,b) it seems clear the drop of the seismicity in this area. According to some studies for various seismicity patterns before strong events which occurred or will probably occur in the studied area [Papazachos,B.C.1980] and to Mogi (1969) concept where gap of the second kind are associated with reduction in

---

1 Veronika PEÇI Seismological Center, Tirana, Albania

number of smaller magnitude earthquake [Marza,V.1981], we can say that the April 15, 1979 earthquake with M_L=7.2 is a seismic quiescence pattern, seismic gap of the second kind. It may be noted that this earthquake took place in the middle of this area (Kotor-Budva in Dalmat coast and Kepi i Rodonit in Albania), [Kociaj,S.1983].

According to studies for the seismicity of Balkan region, the magnitude of this earthquake is the same range with the maximum expected magnitude (6.5-7.0) for this area, [Fournier,D.A. 1979, Kociaj,S.1983, Papazachos,B.C.1992]. Some studies for the preseismic quiescence before large earthquakes have been reported too, [Karakaisis,G.F., etc. 1987; etc.]. So, we have accepted that the characteristic of the seismic pattern in the April 15, 1979 earthquake is in fair accordance with the concept for the seismic gap of the second kind [Mogi, 1969, Utsu, 1968, Marza, 1981].

The concept of the seismic quiescence are used in other our studies, as well as, in April 15, 1979 earthquake and November 30, 1967 with M_L=6.6.[Kociaj, S.1976,1983].

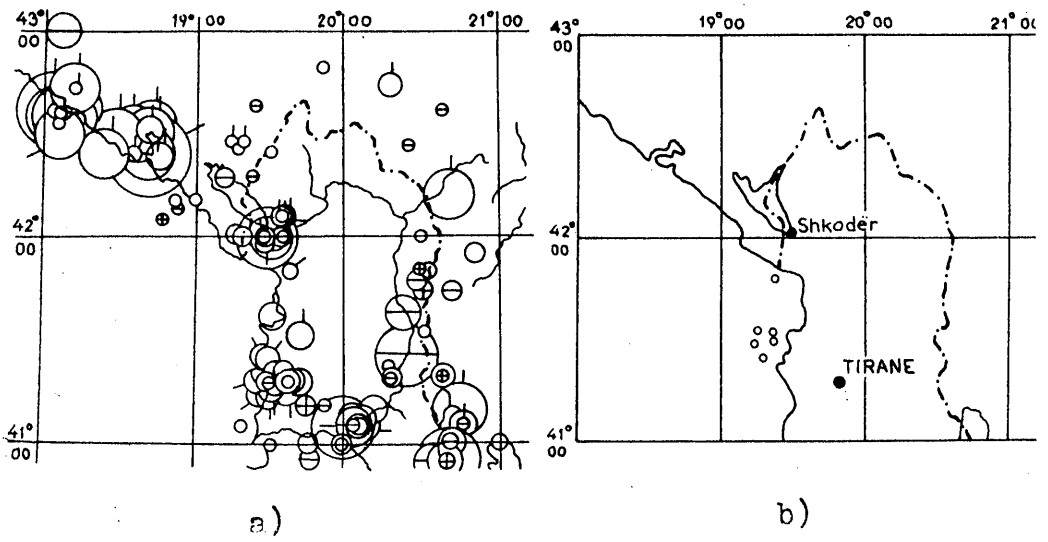

Fig.1 a,b. The distributions of the epicenters for 41.0°-39.0°N, 18.0°-21°E, for period a)1901-1970 (M>5.0) b)1971-1978 (M>4.0)

2. THE VARIATIONS OF "b" COEFFICIENT

We have mainly seen "b" coefficient variation according to Gutenberg-Richter's formula, which is considered as an important seismotectonic parameter and considered in more studies as an earthquake precursors as well as in April 15, 1979 earthquake [Kociaj,S. Peçi,V., 1983].

On November 16, 1982 an earthquake of M_L = 5.5 hit the departments of Fieri and Lushnja situated in the Central and Western part of Albania. The variation of "b" coefficient is studied about 2 years before this shock took place. The changes of this coefficient is very significant in this case. Before the earthquake took place it decreases and just at the eve of the shock takes its normal value [Peçi,V.,etc.1987].

Another earthquake with magnitude M_L=5.4 occurred in Tirana zone on January 9, 1988. This event have been studied too, [Sulstarova, etc. 1988]. The variation of "b" coefficient in this earthquake is significant [Peçi, V. 1989]. In case to have a good assessment about the variations of "b" coefficient as an precursors, we have study too, the seismic activity for the area with coordinates 40.75°-41.75°N and 19.25°-20.25°E for the period 1976-1988. They estimated the catalogue to be complete and homogeneous for M>=2.5.

The earthquake of November 16, 1982 situated in the south part of this area. After this shock, the seismic activity concentrated in the north part, where on November 21, 1985 after tree years of the first earthquake another one occurred in Kepi i Rodonit zone with magnitude M_L=5.2 (see fig.2). In the middle of this area, on January 9, 1988, exactly after tree years against an earthquake with magnitude M_L=5.4 hit the Tirana zone. The variations of "b" coefficient for this area shows clear that, before the each shock took place it takes the lower value than the average of this parameter for hole our territory. In the eve of the shock, this value have tendency to grow up (see fig.3).

To relate this phenomena with the development of the seismic activity, we have show too, the seismic regime parameters for this area for the period more than ten years see fig.3, [Peçi,V. 1989]. In this situate we can say that, the variation of some parameters for the studied area, are very significant.

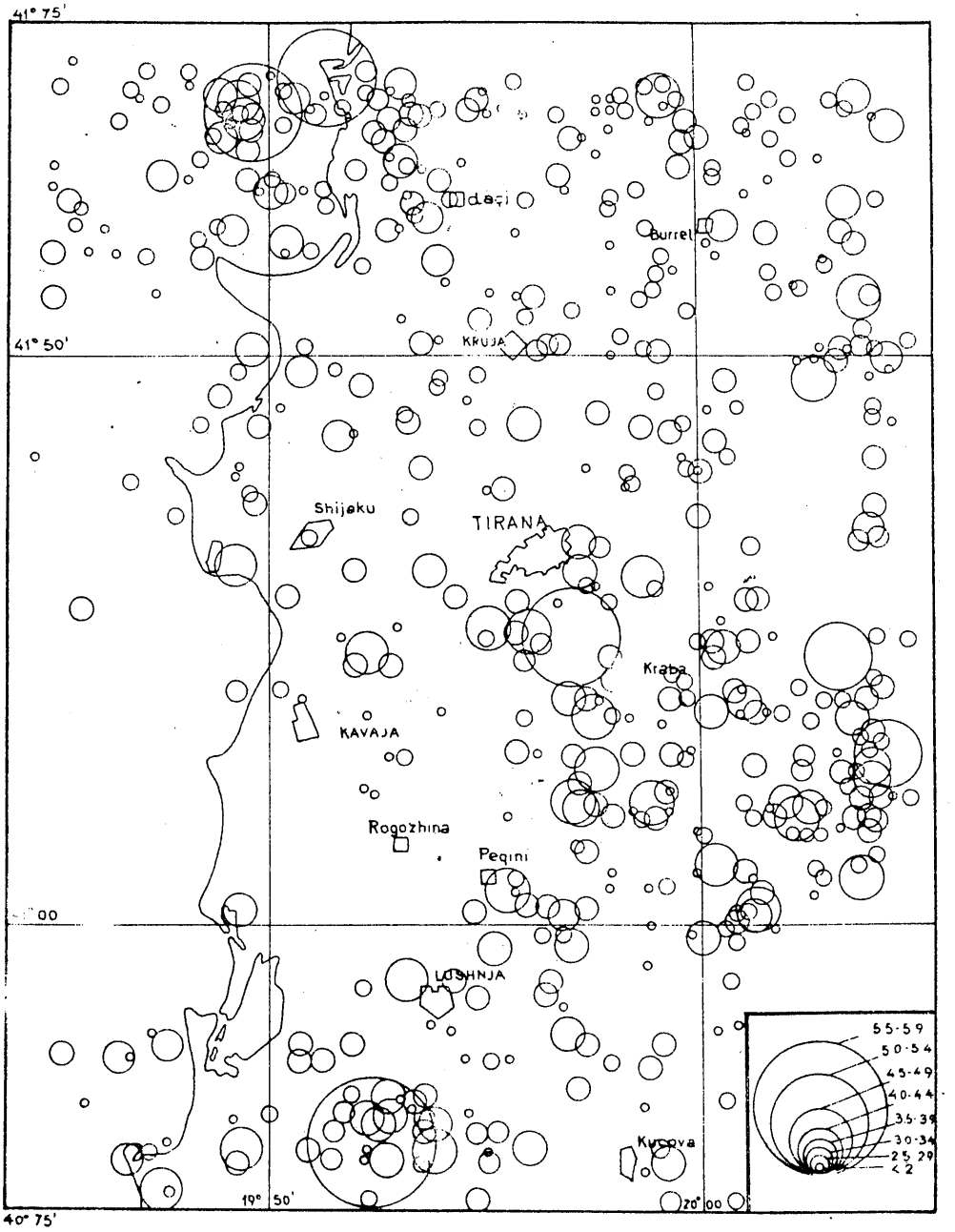

Fig.2 The distribution of the epicenters for 40.75^{o}-41.75^{o}N, 19.25^{o}-20.25^{o}E for period 1977-1988 (M_L>2.5

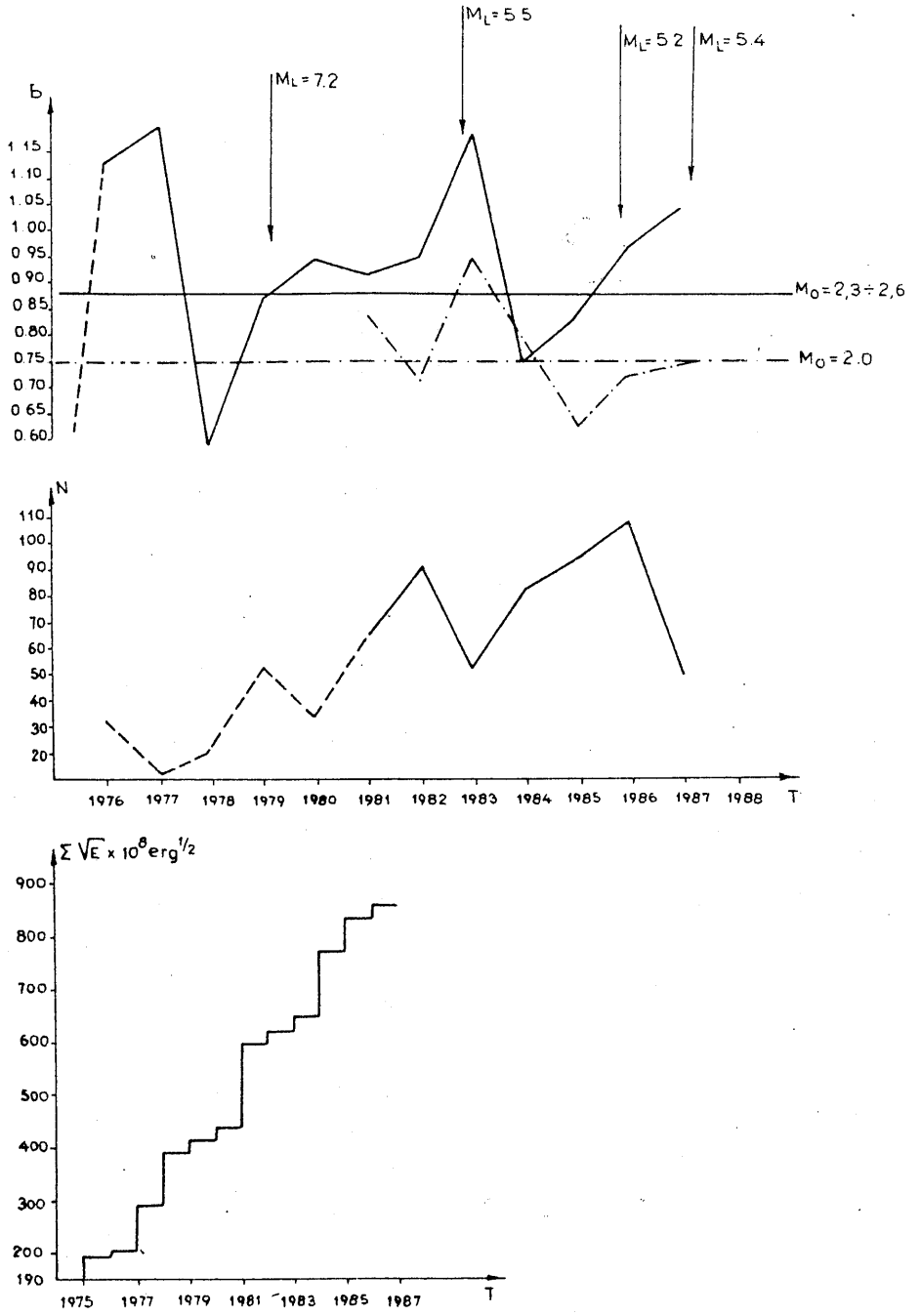

Fig.3 The variations of the seismic regime parameters for the zone 40.75^{O}-41.75^{O}N, 19.25^{O}-20.25^{O}E

3. Vp/Vs IN THE APRIL 15, 1979 EARTHQUAKE (M_L=7.2)

According to many observations in world this ratio changes before strong earthquakes. This phenomena is related to the earthquake physical model but there is not found any acceptable solution for all opinions yet. However, efforts are still in course this ratio may estimate.

This ratio is studied only for April 15, 1979 earthquake considering 245 foreshocks and aftershocks recorded from 6 seismological stations of our network situated at the Eastern and Southeastern part of its focal zone. The evaluation is carried out making use of two methods (Wadat and Smith) [Peçi, etc., 1988]. This ratio calculated for a short period: January 1979 - 19 April 1979 (foreshocks and aftershocks of April 15, 1979 earthquake).

During January 30, 1979 - April 9, 1979 Vp/Vs is stable (1.92) but it doesn't mean that this value is its average one for the period before this strong earthquake (April 15, 1979) take place (fig.4). As we cannot estimate this ratio before this period, for we lack the necessary data, the variation of this ratio from its average value isn't known, but, therefore, there is noticed a tendency. From April 9 up to the eve of the main shock there is observed a decrease of this ratio, and then it takes its maximal value up to 2.1. Just at this time took place the earthquake (M=7.2).

The identification of the anomaly before of this strong earthquake fit well with some different studies [Sulstarova, E., 1983; Kociaj, S.1983; Peterschmitt, E.1983 etc.] for this earthquake, as well as with the anomalies of "b" coefficient, [Kociaj. S, Peçi. V. 1983], the alternations of Vp/Vs ratio [Peçi. V, 1990], with the anomalies in the Radon content of spring water of Warmbad Villach in Austria [Friedman,H. 1985] etc.

We show an attempt related with behaviour of some precursors before some strong earthquakes but, we are of the opinion that the studies of earthquake prediction need common efforts of all scientists.

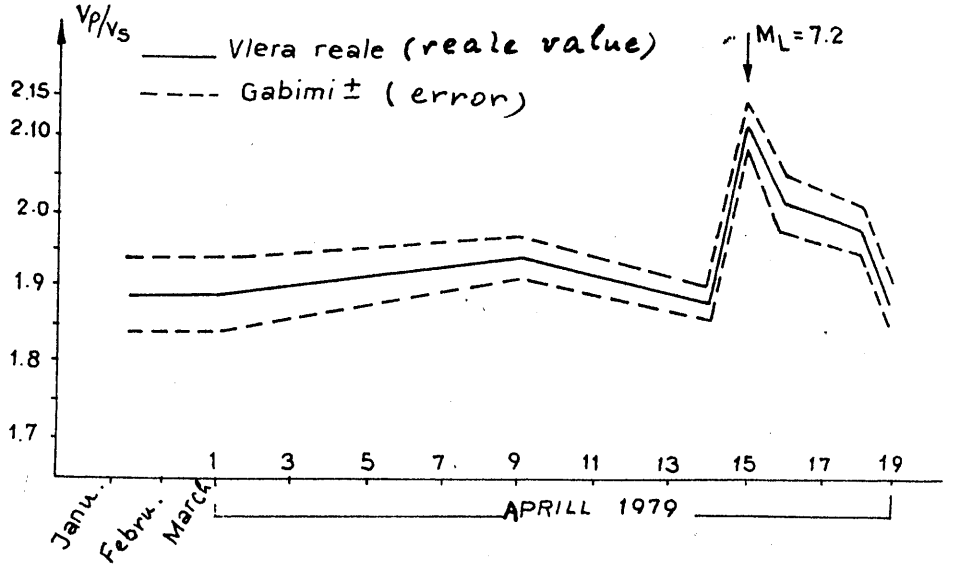

Fig.4 The Vp/Vs variation for April 1979 earthquake (M_L=7.2)

REFERENCES

1. Fournier d'Albe,E.M. 1983. Some aspects of earthquake risk management. - The earthquake of April 15, 1979. Shtepia botuse "8 Nentori", Tirane.

2. Friedman,H. 1985. Anomalies in the radon content of spring water as earthquake precursor phenomena. Earthquake Predict. Res.3, 179-189.

3. Karakaisis,G.F.,Panagiotopoulos,D.G.,Krimnianiotou, M.Ch., Papazachos,B.C. 1987. Preseismic quiescence before large earthquakes in the Aegean and surrounding area. Annals Geophysical, 87/02 B, 155.

4. Kociaj,S., Peci,V., 1983. Disa vecori te paragoditjeve te termetit te 15 prillit 1979. - Termeti i 15 prillit 1979. Shtepia botuse "8 Nentori", Tirane.

5. Kociaj,S. 1976. Epiqendrat e termeteve te Shqiperise dhe rreziku sizmik. Disertacion per kerkimin e grades shkencore "Kandidat i Shkencave". Qendra Sizmologjike, Tirane.

6. Kociaj,S.1983. Earthquake prediction and instrumentation. - Proceeding of a seminar held at the University of Thessaloniki, November 23-26,1981, Thessaloniki.

7. Marza, V.1981. Earthquake prediction: Seismicity quiescence as a premonitory pattern. Proceedings of the 2nd Inter. Symp. on the Analysis of Seismicity and Seismic Hazard. Liblice, Czechoslovakia, May 18-23, 1981.

8. Mogi, K. 1969 - Some feature of recent seismic activity in and near Japan (2). Activity before and after great earthquakes. Bull. Earthq. Res. Inst. Univ., Tokyo 47, 395-417.

9. Papazachos, B.C. 1980. Seismicity rates and long-term prediction in the Aegean area. Quaterniones Geodaesiae, 3,171-190.

10. Papazachos,B.C. 1992. A time and Magnitude-predictable model for generation of shallow earthquakes in the Aegean area. Pageoph, Vol.138, No.2, p.288-308.

11. Peci, V., Minxhozi, A. 1987 - Percaktimi i koeficientit "b" me shperndarjen kumulative sipas magnitudes per disa termete te vendit tone, Bul. Shk. Gjeologjike Nr.3, Tirane.

12. Peci, V., Minxhozi, A., Pitarka, A. 1988 - Mbi raportin e shpejtesive te valeve Vp/Vs per termetin e 15 prillit 1979, Bul. Shk. Gjeologjike Nr.4, Tirane.

13. Peci,V. 1989. Prirja afatmesme e aktivitetit sizmik ne disa zona te vendit tone. Disertacion per kerkimin e grades shkencore "Kandidat i Shkencave". Qendra Sizmologjike, Tirane.

14. Peterschmitt, E. 1983. The destructive earthquake of April 15, 1979 extension of the seismic activity. - The earthquake of April 15, 1979. Shtepia botuse "8 Nentori, Tirane.

15. Sulstarova E., Muco B., Peci V., Pitarka A. 1988 - January 9, 1988 earthquake, Tirana, Albania. Proceedings of XXI Assembly of ESC, 23-27 August 1988, Sofie, p.127-134.

16. Utsu,T. 1968. Seismic activity in Hokkaido and its vicinity. Geophys. Bull. Hokkaido Univ. 20, 51-75 (in Japan).