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ACADEMY OF SCIENCES OF ALBANIA

**SEISMICITY, SEISMOTECTONICS AND SEISMIC
HAZARD ASSESSMENT IN ALBANIA**

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EXTENDED SUMMARY IN ENGLISH

FIRST PART: SEISMICITY AND SEISMOTECTONICS OF ALBANIA

PREFACE

More than forty years seismological studies in Albania have produced a huge material where are uninterruptedly recorded underground tremors of this country, documented and archived seismograms, collected information on felt and damaged earthquakes, carried out expeditions on active tectonic faults, investigated seismicity and seismotectonics, studied the characteristics of tremors and crust of Albania as well as evaluated and assessed the seismic hazard which is very important for building up of dwelling places and infrastructure of a country where earthquakes have a lot damage in the past and expected also to damage in the future. All these studies have a great value on the mitigation of earthquake effects and on reducing the damages these demoniac phenomena are able to cause.

The earthquakes such kind of phenomena that can't be restricted by geographical borders. The strong earthquakes of Albania are felt and happened to produce damages in neighbor countries up to Italy. The same way, it happened to do the earthquakes with hypocenters in neighbor countries and Italy. This made that Albanian seismology to have even in the period of communist isolation some communication, change of the data and joint projects with homologue sciences of different Balkan and European countries, a chance that no many sciences have had in Albania. Various international projects of UNDP, UNESCO, UNDRO, European Community, Science for Peace Program of NATO as well as mutual projects with homologue organizations in other countries and the devotion and passion of generations of people worked in the field of seismology made that the technology of records, data computerization and quality of seismological to be more or less in the state-of-art level. The democratization of the county boosted more the development of seismology in Albania making the Institute of Seismology in 15 years of its existence one of pillars of natural and technical sciences of the Academy of Sciences of the country.

In this book is included the whole experience of more than 40 years studies in the field of seismology, given outputs reached through scientific debate and deep understanding and climaxed on the fulsome form of seismic hazard of the country, a documentation with practical importance for constructions in Albania.

The book has two parts. The first one consists of three chapters where in the first is studied the seismicity of Albania, given description and catalogs of strongest historical and instrumental earthquakes, the atlas of isoseismal maps of shallow earthquakes and macroseismic data collected as well as the parameters derived from such a data. The chapter ends with the influence of soil conditions and topography in the distribution of earthquake intensities and the outputs of seismic microzonations for main cities of the country.

In the second chapter are studied peculiarities of activity and distribution of earthquakes in Albania. The chapter deals with to-days seismic activity, frequency-magnitude relationship,

earthquakes periodicity, their energy, magnitude, depth and typology. In this chapter are included also hydroseismicity, focal mechanism and stress field, induced seismicity, main characteristics of seismic source zones and calibration of seismic activity and maximum magnitude.

The third chapter deals with neotectonic structure of Albania and active seismic faults. There are recognized four large neotectonic units based on tectonic regime and deformation types formed in neotectonic periods. These units are: internal area of Alpine folding affected by extensional tectonics since Pliocene; external area of Alpine folding strongly affected by pre-Pliocene compressional movements; Periadriatic Foredeep strongly affected by post-Pliocene compressional movements and Pliocene-Quaternary Foreland in Adriatic and Ionian off-shore. In this chapter is treated also the front of Albanian orogen, riding over Adria microplate and are given the zones of active faults in Albania.

The second part of the book dwell at length the seismic hazard of Albania. The first chapter comprises the history of seismic hazard studies in the country and method and conclusions of deterministic approach.

The second chapter which is somehow the main conclusion of the book deal with evaluation of probabilistic seismic hazard. Given the catalogue of earthquakes for the period 58-2005, with magnitude, $M_s > 4.5$, the M_{max} has been calculated as well as return periods and probabilities for some return periods for different magnitudes of earthquakes in Albania. The methodology of Cornell-McGuire using a version of EZ-FRISK 7.12 software produced by Risk Engineering Inc. Colorado, USA.

Through this analysis the maps of seismic probabilistic hazard for two levels of probability, for maximum acceleration PGA and spectral acceleration SA are obtained for 5 shaking periods. In a tabular form are given the values of seismic hazard (PGA and SA) for 370 municipalities of the country as well as full spectral values SA(g) for 36 cities together with corresponding spectra uniform hazard for each city for periods 0.1 to 2 sec.

These maps should substitute the Map of Seismic Zonation of Albania in the scale 1:500,000 (approved by Council of Ministers on December 1979).

The book is dedicated to all specialists of earth sciences in Albania, scholars, engineers and technicians who worked and working passionately and zealously in Seismological Center, Seismological Institute, Institute of Earth Sciences and all other organizations of the country connected with the field.

INTRODUCTION

The earthquakes are a geological phenomena where obviously demonstrates the dynamics of the planet we are living in. They express in the fullest way vigorous energy that Earth accommodates in its depth as a still new planet. These phenomena are cause of furious changes in the planet's surface accompanied with its continuous evolution.

As ruinous phenomena, the earthquakes brought huge damages to humanity in the course of centuries. Only in the first decade of 21-st century, the earthquakes and tsunamis left 700,000 dead throughout the world (USGS: *Earthquake Facts and Statistics*, <http://earthquake.usgs.gov/earthquakes/eqarchives/year/eqstats.php>). Other millions were dead through human history and material damages from these phenomena have been tremendous.

Nevertheless, these phenomena have served not only as a source of destruction but as a source of valuable knowledge and geological information too. The analysis of seismic waves provided earth scientists with detailed and uncial information on earth's depth. Being kind of phenomena one can't avoid in any means, the humans tried to coexist with them finding the most appropriate forms to make as harmless as they could their occasional occurrence. And the best way to realize that is deep understanding of these phenomena. Knowing the peculiarities of earthquakes, the tectonic fault that generate them, the distribution in time and space as well as seismic hazard and risk is something that cannot prevent the occurrence of these earthquakes but this knowledge makes possible the development of engineering structures being able to withstand the maximum magnitude earthquake expected for the given area. This way it can be saved life and minimize other losses.

Albania and Balkan peninsula where it makes part belong to Alpine-Mediterranean seismic belt which passes from Azores Islands through Mediterranean and Balkan regions going far east t6hrough Asia joining with Pacific belt on Malaysian Peninsula. The energy released from the earthquakes of this belt amounts to 15% of total energy released from the earthquakes of whole globe. The seismicity of Balkan is the highest one in the Europe caused from multiple interactions of plates in Aegean and Adriatic Sea and complicated tectonics in Carpathian. In this area the meaning of plate tectonics is specially complex from the presence of numerous blocs and the release of stress through plastic deformation in most of this area. The region includes blocks relatively rigid as Adriatic, some sectors of Alpine belt, Alps, Carpathian, Balkan Mountains, Dinarides, Helenides and Hellenic Arch and Anatolian belt as well as inner basins like Tirren, Aegean, Panonian and Black Sea. The most seismic part here is Aegean and surrounding zone where are included Greece, Albania., Montenegro, South Bulgaria and West Turkey. Almost every year this area (34 - 43°V; 18 - 30°L) is hit by an earthquake with $M > 6.5$ (Papazachos, 1988). Leaving apart Hellenic Arch where African plate plunged under Euroasian one in a form of a subduction, the other part of the contact of abovementioned plates and precisely that starts where ends up west wing of Hellenic Arch and which continues on west shores of Balkan, realizes through the Adria microplate which forms a wedge between Apennines, Alps and mountain range Dinarids-Albanids-Helenids.

The origin of orogenic systems of western Balkan as well as the ones surrounding on north and west Adriatic Sea is connected exactly with convergence between Euroasian and African plates. This process that kicked off at Upper Jura - Lower Cretaceous disappeared the ancient ocean Tethys which existed between two continental margins and whose relics are today ofiolites and abyssal sediments found on the napes comprising the above orogenic systems.

The conclusions of many studies on geodynamics and seismicity of Aegean and generally of eastern Mediterreanea - the areas where Albania is included - converged in idea that mainly seismicity of Albania is strongly connected to the contact of Adria with Albanides orogen, which is part of broader collision between Euroasian and African plates. This contact which seems to be realized through a continental type of collision, accumulates continuously deformations putting in movement both tectonic longitudinal faults that laying down the contact and tectonic shear faults cutting it entering deep into the peninsula. There are precisely these continuous accumulations of tectonic deformations those who through active faults - the earthquakes' cradles - release seismic energy contouring this way the seismicity of the country.

CHAPTER I

SEISMICITY (*E.Sulstarova, B.Muço, S.Koçiu*)

The seismicity of a certain region is determined as a function of earthquake size (magnitude, intensity, seismic moment etc.) as well as the frequency of their occurrence. On this basis, keeping in mind the wellknown classification of earthquakes according their magnitudes (Hagiwara, 1964; Lee and Stewart, 1981), the seismicity of Albania is characterized from an intensive seismic microactivity ($1.0 < M \leq 3.0$), from many small earthquakes ($3.0 < M \leq 5.0$) from rare medium-sized earthquakes ($5.0 < M \leq 7$) and very seldom from strong earthquakes ($M > 7.0$).

Historical seismicity (*E.Sulstarova,S. Koçiu*)

The historical seismicity of Albania is described in some various catalogues as: Moreli, 1942; Mihajlovic, 1951; Shebalin et al. (Eds.), 1974; Sulstarova and Koçiaj, 1975; Makropoulos and Burton, 1981; Papazachos and Papazachou, 1989.

From the evidence we possess today it's results that from the period of III –II centuries B.C till in our days, Albania has been stricken from 55 strong earthquakes with intensities $I_0 \geq VIII$ degree (MSK-64), from which 15 of them have had the intensity $I_0 \geq IX$ degree (MSK-64) (FIG.1). From these 55 earthquakes for a period more than 2000 years, 36 of them belong to 19th century which make us to believe that the number of disastrous earthquakes we report is underestimated and other disastrous earthquakes are hidden on the depth of historical time.

There are reliable evidence that old town of Durres (Dyrrahum) has been stricken several times from strong earthquakes caused serious human and economic losses. From old cronicles results that this town has been almost totally destroyed on the year 177 B.C, 334 or 345 A.C., 506, 1273, 1279, 1869 and 1870. The evidence for the earthquake of March 1273 says that the town with 25 thousand people of that time has been totally destroyed. There were many casualties and the survived people left the town seeking for other living places. After this earthquake the importance of Durresi town as a port in Adriatic Sea has been diminished.

On the centuries III-II B.C. there are evidences that Apolonia, another ancient town, has been stricken from strong earthquakes which caused large casualties and damages.

On the year 1153, the town of Butrinti (old Buthrot) on the south of Albania, has been destroyed from a strong earthquake. Its traces could be finding even today on the remnants of this old town.

Some descriptions of the strongest historical earthquakes are given here:

The earthquake of October 12, 1851

At October 12, 1851, around 07 o'clock a strong earthquake hit the gulf of Vlora. In Vlora town a part of buildings was destroyed and the other part was heavily damaged. According

to the news of that time the number of casualties was about 200. Kanina village was heavily damaged, as well. The sea level in Vlora bay arose 66 cm and inundations were observed. Before the main shock at 02h 40min(?) a weak foreshock was felt in Vlora town. The strong main shock (07 h) was followed by a great number of aftershocks.

The earthquake of October 12, 1851 was strongly felt in Italy, causing panic among the population of Taranto, Bari, Barleta, Canosa and Cerignola. It was felt 5 degrees at Ioannina (Greece) and 3-4 degrees at Naples (Italy). According to other data serious damage was observed at Berat. Previous authors did not mention Berat, but Himara. According to our opinion this earthquake caused damage in both these towns (Vlora and Berat). The highest intensity of this earthquake had to be 9 degrees and its epicenter at coordinates $40^{\circ}.5$ N, $19^{\circ}.5$ E

The earthquake of October 17, 1851

On October 17, 1851 a very strong shock caused a lot of destructions in town of Berati. The fortress of the town was damaged and under it's ruins 400 soldiers were buried. This fact showed that other victims had to be observed in town of Berati. Cracks on the ground were observed together with fountains of sands and water mixed together, and a kind of a sulfur dust, which made the respiration difficult, was observed. Big landslides were observed as well. The highest intensity for this earthquake had to be 9.0 degrees (based mainly on the degree of the destructions of the fortress of the town).

The earthquake of June 14, 1893

On June 14, 1893 a destructive earthquake hit the region of Himara and especially the village Kudhes was totally destroyed. Rock-falls and cracks on the ground were observed over a considerable area (up to the village Fushe-Bardhe of Gjirokaster where the damage was considerable). Majority of the dwelling houses was destroyed in Kuç village (Vlora) as well. In the epicentral area all buildings were destroyed (even a church built on rocks at Çorraç village (Saranda district)). This earthquake was still alive in the memory of the population of the epicentral area in 1966, when the earthquakes of intensity 7 degrees were observed. The earthquake of June 14, 1893 caused a big panic among the population.

The damage caused by this earthquake is covering a wide area up to the village of Narta (Vlora). Consequently the highest observed intensity of this quake had to be 9 degrees with the epicenter nearby the village of Kudhes and Çorraç (Hundraçi mt.): $40^{\circ}.1$ N $19^{\circ}.8$ E.

This earthquake was felt in Puglia, Italy as well.

Instrumental Seismicity (E.Sulstarova, B.Muço, S. Koçiu)

The establishment on the end of 19th and especially the beginning of 20th century of seismological stations in Europe made possible even the evidence of earthquakes occurred in Albania and nearby. Depending from the density and modernization of seismological stations in Europe and worldwide one can say that the earthquakes of Albania and nearby with magnitude $M_S \geq 6.0$ (so with intensity $I_0 \geq VIII$ (MSK-64)), are recorded from the seismological stations since the beginning of 20th century; those with magnitude $M_S \geq 5.5$ (intensity $I_0 \geq VII$ (MSK-64)), since 1911; those with $M_S > 5.0$ (intensity $I_0 > VI$ (MSK-64)), since 1940; those with $M_L \geq 4.0$ (intensity $I_0 \geq IV-V$ (MSK-64)), since 1968 and those with magnitude $M_L \geq 2.5$, since 1976.

From the data collected and elaborated it is evidenced that during 20th Albania has been stricken by many damaging earthquakes. The earthquakes more disastrous and in the same time with the highest magnitude occurred in Albania during 20th century are :

The earthquake of the 1905 year (Shkodra earthquakes)

Represents one of the biggest series of strong earthquakes of Shkodra valley. The highest intensity, big number of aftershocks and consequences of the main shock and strongest aftershocks had been the subject of many seismological studies (Kociaj and Sulstarova, 1980). The strongest shock occurred on June 1, 1905 at 4 hour 42 min 43 sec (GMT). This shock was recorded by a big number of seismological stations of the time despite of their lower sensibility. The magnitude of this earthquake was determined as 6,6. The duration of the earthquake on June 1, 1905 was 10-12 sec and caused big damage among the population and property in town of Shkodra (42.05⁰N, 19.50⁰E) and surrounding villages (especially in the villages SE to Shkodra). Were completely destroyed about 1500 dwelling houses only in Shkodra town; all other buildings of this town were heavily damaged. This shock caused about 200 dead and about 500 injured.

The highest intensity of this shock was observed in SE part of Shkodra town (at Bahcallek, 3 km SE of the today center). In Bahcallek (42.02⁰N, 19.52⁰E) all houses were totally destroyed; no house survived. According to witnesses during the earthquake the houses were going up and then falling down were destroyed. Bahcallek was transformed in ruins. At Bahcallek, the bridge crossing the Drinas River was damaged (its stone legs), but the bridge itself was safe. The walls of Shkodra fortress were damaged and partly fallen. The stones of these walls damaged many buildings situated down of the fortress especially in the quarters of Allajbeg and Tabake. From the big cracks on the ground at Bahcallek, colossal quantities of the water spread out indicating the area. According to a witness during the earthquake a horse with a pop on it was passing across Drinas River. At the beginning the river had very few water but at the end of the earthquake the level of the river's water overflowed the horse's knees.

The river's waters of Drini, Drinas and Kiri rivers overflowed their banks. A sulfur smelling dust was propagated into the air. Between Berdica and Bahcallek villages big cracks on poor soil conditions were observed, interrupting somewhere the roads. From these cracks big quantities of white water spread out. There are witnesses speaking about soils waveforms in pleistoseismal area. In Berdica village all houses were destroyed. In Shkodra town the intensity of the shock was one degree less than in Bahcallek. In Shkodra all houses were seriously damaged and many of them were destroyed. Were damaged the churches of the town including that of Franciscans under the constructions. The upper part of Jesuits church subsided, all cupolas of churches cracked. Less damage was observed in the Old Bazaar of Shkodra. In many water wells of the town anomalous phenomena were observed concerning the underground water regime, sometimes the water was lost. In Trush village all houses were totally destroyed. Big cracks were observed on the soil. Three big holes of the depth of 15 m from which a big quantity of the water spread out were created. There are data indicating about the subsidence of the area around this village, but there is a lack of accurate topographic data of that time. During the main shock, an Italian ship named "Calanda" was navigating along the Buna river, nearby to Ana Malit region. Big water waves of Buna River frightened the passengers of this ship. In the same time from nearby hills a lot of rock-falls were observed with a big noise towards Buna River. All ships navigating in Adriatic Sea between Buna River's mouth and Tivar (Montenegro) felt this earthquake.

The pleistoseismal area of this earthquake is situated SE to Shkodra town (excluding Old Bazaar) including the villages: Bahcallek (42.02⁰N, 19.52⁰E), Berdice (42.01⁰N, 19.48⁰E), Trush (41.96⁰N, 19.46⁰E), Kozmac (41.99⁰N,19.56⁰E), Beltoje (42.01⁰N, 19.51⁰E), Oblika (42.06⁰N, 19.45⁰E), Barbullush (41.92⁰N, 19.53⁰E) Selite.

Heavy damage was observed later on by the strong aftershock of June 3, 1905 at Lezha (41.77⁰N, 19.65⁰E), Ulqin (41.92⁰N, 19.20⁰E) and Tivar (42.07⁰N, 19.09⁰E) towns and at Podgorica (42.42⁰N, 19.26⁰E) and Tuz (42.33⁰N, 19.30⁰E) as well.

According to the witnesses, the peak ground acceleration during this earthquake had to be very high, especially in Bahcallek and Shkoder where a lot of facts can illustrate that as rotation of small statuettes, setting up of heavy objects and even of heavy stones.

For this shock according to gathered data from different sources an isoseismal map was compiled taking into account those compiled by Mihajlovic and Sieberg (see Sulstarova and Kociaj, 1975).

The highest intensity of this shock had to be 9 degrees and its epicenter at 42° 02'N, 19.5E. This earthquake was felt in Yugoslavian territory, in southern part of Hungary, in Bulgaria, Greece and Italy.

The earthquake of June 1, 1905 is famous for a big number of aftershocks, some of them very strong. These aftershocks continued up to July 1906.

The earthquake of February 18, 1911

On February 18, 1911 at 23 h 35 m (GMT) a strong earthquake hit the region around Ohrid lake. The earthquake caused destruction of many houses in Pogradeci town (40.89⁰N, 20.64⁰E), and villages Starove (40.88⁰N, 20.68⁰E), Tushemisht (40.89⁰N, 20.72⁰E), Zagorcan (40.84⁰N, 20.73⁰E). There were a lot of human casualties. All houses that survived the earthquake were seriously damaged. Heavy damage was observed in all villages of Pogradeci district. The area of serious damage is going southward up to Korca (40.60⁰N, 20.78⁰E) and Bilishti (40.62⁰N, 20.99⁰E) towns where a partial destruction of walls and chimney's fall was observed, eastwards up to Manastir (Bitola) (41.02⁰N, 21.33⁰E) and Prilep (41.35⁰N, 21.55⁰E), northward up to Diber (Debar) (41.52⁰N, 20.52⁰E), where walls were damaged and chimneys fall down. Heavy damage was observed in Ohrid town (41.10⁰N, 20.80⁰E), where besides destruction of many houses, three mosques fall down. The mosques' minarets fall down in Starova village as well. The level of Ohrid Lake arose 50 cm.

This earthquake was felt 6 degrees at Elbasan (41.10⁰N, 20.10⁰E), where slight damage was observed. It was felt 5 degrees at Lecce (Italy); it was felt in Yugoslavian and Greek territory as well (especially at Corfu Island). This earthquake is recorded by a great number of seismological stations of Europe of that time. Its magnitude was 6.7. The highest intensity was 9 degrees and its macroseismic epicenter is situated in southern edge of Ohrid lake at coordinates: 42° 52'N, 20° 45'E. This earthquake was followed by a big number of aftershocks, among which that of February 20, 15 h 15 min heavily damaged the village Hudenisht (41.95⁰N, 20.63⁰E) (Io=7 degrees). The aftershocks continued during all 1911 and 1912 year.

The earthquake of November 26, 1920

It is one of the most powerful earthquakes, which destroyed the town of Tepelena and surrounding villages. According to instrumental data it's magnitude was M=6.4. More heavily was destroyed the town of Tepelena and surrounding villages: Bençe, Turan, Dhemblan, Memaliaj, Kashisht, Salari, Dragot, Luzat etc. 36 people died and were injured 102. In town of

Tepelena, all houses were totally destroyed, except a wooden house. Was seriously damaged even the old fortress: the upper walls fall down and a part of its northern wall was destroyed due to a landslide underneath it. Westward of Tepelena, the stone's legs of Bença Bridge were damaged and the village of Bença was completely destroyed. A two stories water supplier with arches was destroyed as well, except of a part remaining till to present days. The traces of the destruction can be observed even nowadays. According to reports were destroyed or damaged about 2500 dwelling houses and remained houseless about 15000 people. Along the road Vlore-Tepelene- Gjirokaster, a lot of cracks on the ground and rock-falls were observed. As a result a part of the road nearby to place named Ujte e Ftohet (nearby Tepelena) was blocked. On the mountain of Bença a lot of cracks of the width of 50-150 cm of N-S direction were observed. The length of these cracks in some places reached some hundred meters. On SE slope of Trushnica mountain. nearby to Bença village, big slides of limestone's blocks were observed, whose traces could be seen even nowadays. The highest intensity 9 degrees was observed just on Trushnica mountain (between Tepelena town, and villages of Salari and Bença) at coordinates: 40° 16'N 19° 58'E. This earthquake was followed by a great number of aftershocks. The strongest aftershock of November 29, 1920 had the epicenter 20 northward of the epicenter of the main shock.

The earthquake of November 21, 1930

On November 21, 1930 at 02h00min (GMT) in Llogara Pass of Çika mountain (Vlore) a very strong earthquake occurred, which destroyed totally the villages: Dukat, Terbaç, Palase and Dhermi (Gjolekaj & Vretkaj quarters). Were destroyed partially the villages: Smokthine, Velçe, Brataj, Vranisht, Lepenice, Tragjas. The earthquake caused 30 deaths and over 100 injured. Many domestic animals were lost. The damage of dwelling houses was observed over the area from Vlora (North) to Tepelena (East) and to Fterra (South). 20 minutes before the main shock, a foreshock was felt at 01h 04min, which awoke all people and obliged them to left houses. Consequently the majority of the population at the time of the main shock was outdoors (that can explain the rather small number of victims). In the village Dukat, collapsed 188 houses and 140 others became useless. All other houses were damaged. The village Terbaçi was totally destroyed. All 178 houses of this village collapsed. In the village Palasa collapsed 128 houses.

Within a radius of 15 km, in the epicentral area, a lot of dynamic soil instabilities were observed as big landslides, rock-falls and big cracks on the ground on Qore Mountain. Opposite to Terbaç village, a slide of a big rock massive with a forest on it, can be seen even nowadays. On Stogo mountain, two landslides were observed: one at the top of village Terbaç, which reached the village itself and destroyed some houses and another in the village Brataj. Landslides were observed on the western slope of Çika Mountain, that transformed it's landscape and destroyed the roads at this site.

The German geologist Ernst Nowack described one of the most interesting phenomena. "In one case we observed at Llogara Pass, that during the first shock, a big crack was opened on hard rocks of the width of 1 m and of the length of 1 km. This crack followed the crest of the Pass... in some places both banks of this crack were almost vertical ones and have an amplitude of 20 cm; Impression is of a compression without vertical throw." (Nowack, 1934). Without any doubt in this case we have to deal here with a primary phenomenon, which reflects dislocations in the focus. If will take into account the shallow depth of this earthquake ($h < 3\text{km}$), and it's highest intensity (10 degrees), it can be said that dislocations occurred inside surface rocks. There were a lot of reports on

secondary cracks on the ground (in Dhermi, Terbaç, Palase, Dukat), about slides of big surfaces of agriculture land, terraces, olive trees etc.

In all the epicentral area the change of underground water levels was observed. Based on above mentioned data it seems that the epicenter of this shock was situated just at the site named as "Shengjergj step" at $40^{\circ} 12'N$ $19^{\circ} 35'E$. Its highest intensity inside the zone with a radius of 2 km reached 10 degrees. This earthquake was followed by a great number of aftershocks, some of which of high intensity; aftershocks continued for about one year and finished with a strong shock of September 23, 1931 of 13h38min with intensity 8-9 degrees.

The epicenters of aftershocks indicate the activation of the big active fault Vlore-Dhermi. The great number of active faults inside this region favored the distribution of seismic energy.

The earthquake of September 1, 1959

At 11h37m(GMT) of September 1, 1959 an earthquake of magnitude $M=6.2$ hit the villages close to Kuçi bridge (Lushnje district) and towns of Lushnja, Fieri, Rogozhine, Peqin, Kuçove and Berat. All dwelling houses in the villages of Karbunare (Lushnje) were damaged, although a part of them were of good quality constructions. In Karbunare e Vogel 32 houses collapsed, 44 houses suffered severe damage and 15 were slightly damaged. In Karbunare e Madhe 26 houses collapsed; 17 suffered severe damage and 23 slight damaged. In Lushnja were damaged 693 house: 51 collapsed 407 suffered severe damage and all others suffered slight damage. Among important buildings damaged by this quake were brick's factory, the town's hotel, the hospital, the cinema, the high school etc. Fieri were seriously damaged; the high school, the building of CP and some dwelling houses. In Rogozhina suffered the oil factory, where shear cracks on the walls of chimney were observed. In Peqin many dwelling houses were damaged and the cupola of the mosque. Damage was observed even in Berat, especially in the quarter situated on terraces of Osumi River. Other part of the town situated on limestones had no damage. Generally all walls of 320° -strike direction fall down. The movement has a direction of $60-70^{\circ}$. Even light provisional houses of wood/dryad grass were damaged but much less than houses of bricks and stones.

In the epicentral area of this earthquake (villages Ngurez e Vogel, Arapaj (Lushnje), Strume, Çukas, Kurjan dam (Fieri), Kozare (Kuçove), Çiflik-Poshnje, Pashalli (Berat) a lot of dynamic soil instabilities due mainly to the liquefaction phenomena, were observed. In all these places cracks on the ground of general strike $NE 50-60^{\circ}$ and $NW 300-320^{\circ}$ were observed of the width of 20-25cm and of the length of some hundred meters (in Çukas, Çiflik, Kozare, Arapaj) and much smaller in the villages Ngurez e Vogel and Pashalli. The same phenomena were observed on the banks of Osumi river nearby Çiflik & Pashalli villages. From all these cracks, the fountains of water mixed with sand and pseudovolcanoes of sands of diameter 0.3-1.0 m were observed. Nearby to Ura e Kuçit bridge in a particular site, traces of seismic fault of strike-slip dextral movement were observed; strike direction of the fault $NE 70^{\circ}$.

Before the main shock, some strong foreshocks were recorded and observed as those of: August 17, at 04h29m, $M=5.8$; August 17, at 01h33m, $M=4.5$.

Despite of big energy of the first one ($M=5.8$) it hadn't caused big damage and its intensity was no more than 7 degrees in Lushnja town (42 houses suffered heavy damage and 52 others slight damage). The earthquake of September 1, 1959 was followed by a big number of aftershocks among which two had the magnitude higher than 5.0: September 3, 1959 at 04h02m($M=4.5$, $I_0=6$ degrees) at $40^{\circ}.75N$ $19^{\circ}.71E$; October 5, 1959 at 20h34m($M=5.1$, $I_0=7$

degrees) at 40°49N 19°50E; October 7,1959 at 08h30m(M=5.5,Io=7-8 degrees) at 41°00N 19°80E.

The earthquake of May 26, 1960

On May 26, 1960 at 05h 01m (GMT) the region of Korca was hit by a very strong earthquake of magnitude M=6.4 and intensity 8-9 degrees, which caused serious damage in Korca town and surrounding villages, especially in localities of Lavdar (40.55⁰N, 20.65⁰E), Vithkuq (40.52⁰N, 20.58⁰E), Voskopoja (40.63⁰N, 20.59⁰E) and Korca (40.60⁰N, 20.78⁰E). From this earthquake results 7 people died and 127 injured. In Korca town were damaged altogether 1479 houses: 103 collapsed, 878 suffered heavy damage and 470 medium damage. All other dwelling houses suffered slight damage. Were damaged electric and water supply's networks. According to statistic of Executive Committee of the town 25% of dwelling houses of Korca town became useless.

In above-mentioned localities collapsed 309 houses, suffered heavy damage 488 and slight 628. The villages: Polene (40.58⁰N, 20.69⁰E), Lavdar (40.55⁰N, 20.65⁰E), Gjergjevice (40.65⁰N, 20.65⁰E), Dersnik suffered heavy damage. According to statistics of Executive Committee of Korca district collapsed in villages: Polene, 39 houses; Dersnik, 44 houses; Lavdar, 54 houses; Gjergjevice, 48 houses and Gjonmadh (40.65⁰N, 20.74⁰E), 22 houses.

Damages were observed over a wide area up to Pogradec (40.89⁰N, 20.64⁰E), Permet (40.71⁰N, 20.35⁰E) and Erseke (40.82⁰N, 20.69⁰E) and nearby to Konica (Greece), where 95 houses were damaged and one child was injured. The pleistoseismal area includes the villages: Gjergjevice, Polene, Lavdar. The rock-falls, that interrupted the autoroad Vithkuq-shtyllë and many secondary cracks on the ground were observed in this area. In Polene village some sources of water mixed with metan gas appeared.

This earthquake was followed by a big number of aftershocks, especially the first days after the main shock.

The macroseismic epicenter of the main shock: 40.6N, 20.7E h=19 km Io=9°, M=6.4.

The earthquake of March 18, 1962

On March 18, 1962 at 15h 30m (GMT) an earthquake of magnitude M=6.0 and epicentral intensity 8 degrees, hit Fieri town (40.72⁰N, 19.56⁰E) and surrounding villages. Serious damage was observed in neighboring to Fieri districts of Tepelena, Vlora, Berati and Lushnja. It was felt over all territory of the Republic and even in neighboring countries. Were killed 5 people and injured 77 others. Were damaged 2700 dwelling houses: 1000 collapsed. Were damaged many industrial, administrative, social-cultural and communal buildings.

In Fieri town was damaged the electric and water supply's network and 383 dwelling houses: 66 destroyed (12 collapsed totally, 121 suffered heavy damage and 194 suffered slight damage. In surrounding to Fieri villages were damaged 1335 houses. The dwelling houses, which collapsed, were constructed by concrete blocks without steel. Among damaged buildings it should be mentioned: the hotel "Apollonia", the cotton's factory, the brick's factory, the Culture's House etc. in new building transversal cracks (like a cross) were observed in lower stories. More heavily was damaged the building situated along Gjanica riverbank. It was clear that in this place the poor soil conditions had influenced the degree of damage.

In villages: Mbrostar (40.77⁰N, 19.55⁰E) and Verri (40.77⁰N, 19.57⁰E), the cracks on alluvium and delluvium accompanied with fountains of water mixed with sand, were observed. In Verri an irrigation bridge was damaged. It should be mentioned that some witnesses in

villages nearby to this bridge were speaking about the fact that during the earthquake this bridge goes up and down together with the forest nearby.

The village that suffered more from this quake was the village Reres (nearby Patos town), which was completely destroyed. In this village the width of the cracks on the ground arrived 40 cm and their length up to 100 m. These cracks followed the geomorphologic conditions of the site. On the increase of the degree of damage in Reres village the big influence had to have even unfavorable setting of this village. Based on soil instabilities observed in this village the intensity in this point has to be more than 8 degrees.

In the locality of Ballsh, more seriously were damaged the villages: Uso (40.63⁰N, 19.77⁰E) and Belishove (40.57⁰N, 19.80⁰E). In Uso village 34 houses collapsed; in Belishove 17 collapsed and 172 others were damaged. Heavy damage suffered Ballshi town as well. In Roskovec locality (Fieri district) serious damage suffered especially new buildings.

In Vlora town (40.45⁰N, 19.48⁰E) and villages close to Fieri district, serious damage was observed. In Vlora town itself 71 houses collapsed, 73 suffered heavy damage and all others suffered slight damage. In Vlora district, Trevllazer village (40.57⁰N, 19.48⁰E) was more seriously damaged: 25 houses collapsed and 50 others suffered heavy damage.

In Berati town (40.69⁰N, 19.95⁰E) 32 houses collapsed and suffered serious damage 82 others. More seriously were damaged the villages: Molisht (40.58⁰N, 19.93⁰E), Paftal (40.45⁰N, 19.95⁰E) and Kutalli (40.47⁰N, 19.77⁰E). Slight damage was observed in the district of Tepelena, especially in localities of Krahes (40.43⁰N, 19.88⁰E), Buz (40.43⁰N, 20.02⁰E) and Sinanaj (40.35⁰N, 19.86⁰E).

This earthquake was accompanied with interesting soil phenomena. Pseudovolcanoes of sand and mud were observed from the cracks along river's bank of Gjanica (Fieri), Semani and Vjosa (in Novosele (40.62⁰N, 19.46⁰E), Mifol (40.65⁰N, 19.45⁰E)). All these cracks had been of NNE-SSW orientation.

From above mentioned descriptions it results that the macroseismic epicenter is situated close to Fieri town, 40° 40'N, 19° 36'E and its highest intensity is 8 degrees.

The earthquake of November 30, 1967

This earthquake occurred at 07h 23m and had M=6.6. It caused heavy damage in districts of Librazhdi and Dibra in Albania and in Western Macedonia (Sulstarova and Kociaj, 1980). In district of Debra and Librazhdi by this earthquake suffered 13 localities with 177 villages, died 12 and were injured 174 people. Were damaged 6336 buildings; 5664 dwelling houses, 156 social-cultural objects (133 schools), 534 houses collapsed, 1623 suffered heavy (of 3-4 degree) damage and 4179 suffered medium (second degree) damage. The damage of first degree were observed over a wide are including districts of Elbasan, Tirana, Rreshen, Burrel and Pogradec. Casualties were observed in the Yugoslav territory as well.

In Albanian territory the localities that suffered more were those of Klenja (41.35⁰N, 20.47⁰E), Ostren (41.43⁰N, 20.46⁰E), Lunik (41.27⁰N, 20.33⁰E) and Maqellare (41.58⁰N, 20.49⁰E) and especially villages: Sebisht (41.35⁰N, 20.50⁰E), Zabzun (41.40⁰N, 19.41⁰E), Borove (41.33⁰N, 20.47⁰E), Prodan (41.39⁰N, 20.42⁰E), Ostren i Madh (41.43⁰N, 20.46⁰E), Ostren i Vogel (41.42⁰N, 20.47⁰E), where the observed intensity was at least 9 degrees. Heavy damage suffered villages of Maqellara district, where an increase of seismic intensity was observed compared with villages in the mountains. All the pleistoseismal area represents a mountainous region, where the majority of villages were built on limestone (Zabzun, Borove, Strebleve, Klenje, Lunik) or on flysch sediments (Pervalle (41.30⁰N, 20.33⁰E), Prodan, Ostren i

Madh, Ostren i Vogel, Sebisht etc). In all above mentioned villages were damaged 75-90% of houses and in some special cases (Sebisht, Ostren i Madh 100% of houses. The biggest damage was observed during the contact between limestone and flysch sediments and along the fault created by this earthquake on free surface.

This fault represents one of the most interesting phenomena of this earthquake. It began at Pervalla Pass and continued on quiet topography of delluvium deposits up to the quarter Prodan of Zabzun village. Along all this 1 km of length this fault had a width of 30-50 cm and a vertical displacement from 20-50 cm. This fault had a zigzag form of general strike of NE 40 degrees. In Prodan quarter it cut off a two-story building of stones. It seemed that this building was cut off in two pieces by a big knife. Eastern part of the building subsided 50 cm compared with western part. It is the place of the biggest release of energy. Further on the fault is passing through a hilly region of flysch sediments, along their crest of general strike NE 40°. Along all its length of 10 km a subsidence of northeastern block was observed, compared with SW block. According to our opinion it represent a primary phenomenon of this earthquake. Cross to this fault in many places diagonal cracks on the ground were observed as secondary phenomena.

This earthquake was accompanied by many rock-falls especially in the epicentral area and far away as well, by the distribution of underground waters, by the high acceleration (1.25g), big number of aftershocks recorded. The number of aftershocks arrived up to 1200. The strongest one was that of December 2, 1967 at 12h 44m, M=5.3, Io=7-8 degrees at 41.25N 20.35E. Its epicenter is SW to that of mainshock: between Lunik and Pervalle.

The earthquake of April 15, 1979

The earthquake of April 15, 1979 (so-called the Montenegro earthquake), is one of the strongest earthquakes occurred in the Balkan Peninsula during the 20th century. Its magnitude has been evaluated from 6.6 to 7.2 and in our catalogue we assigned the value of M=6.9 (Karnik, 1996). The epicenter of this earthquake is in the coastal area, near Petrovac, Montenegro. It happened at 06^h 19^m of April 15, 1979. Many foreshocks occurred about two weeks before the main shock of April 15, and the aftershocks continued for more than 9 months. The strongest aftershock is that of May 24, 1979, with magnitude M=6.3. The intensity of this earthquake in epicenter is IX-X degree (MSK-64). The main shock of April 15, 1979 earthquake caused 35 casualties in Albania and 382 injuries. More than 100.000 inhabitants (mostly in the districts of Shkodra and Lezha) were left homeless. There were destroyed almost completely 17.122 dwelling houses and social-cultural facilities. The more casualties and economic loss were caused on the coastal part of Montenegro. The earthquake of April 15, 1979 has been felt strongly in all territory of Albania. It has been felt IV degree (MSK-64) at Northwestern Greece, Croatia, Slovenia and Eastern Italy. There are reports that the earthquake has been felt up to Austria and Switzerland (Sulstarova and Muço, 1983).

The earthquake of April 15, 1979 has been accompanied by a lot of physical-geological phenomena on the ground. In Shkodra and Lezha districts were evidenced many soil cracks, liquefaction phenomena, river banks subsidence and rock falls (Shehu and Dhima, 1983; Dibra, Z., 1983).

The earthquake of Tirana, January 9, 1988

On January 9, 1988, 01^h 02^m (GMT), an earthquake with M=5.4 hit Tirana city and the villages nearby causing relatively slight damages. The epicenter of this earthquake is situated ten kilometers on the southwestern part of Tirana city. The highest intensity reached VII degree (MSK-64). The most damaged were the villages of Petrela, Arbana on the south of Tirana. Slight damages were evidenced even in Tirana City especially on the northwestern and western part of it.

It is worth to be mentioned that for this earthquake, the strong motion instrument installed in Tirana seismological station recorded a very high and unusual value for maximum acceleration in E-W component: 404.8 cm/s. It can be explained by the fact that the strong motion instrument has been very near to the fault, which generated this earthquake (Sulstarova et al. 1989).

Maximum observed intensities

Generalizing the isoseismal maps of the strongest earthquakes, using the maximum intensity observed in all inhabited centers, from Albanian earthquakes epicenter map (taking into consideration the relations derived for the macroseismic field), the map of the maximum observed intensities for the period 1800–2005 was compiled. This map presents the maximum surface effects of the earthquakes in our country.

Influence of soil condition on earthquake intensities

The physical-geological phenomena accompanying in many cases strong earthquakes are a very important factor to be considered on hazard analysis of a country. Such phenomena are evidenced during earthquakes of Albania especially on the Periadriatic Depression. Some ground phenomena accompanying the earthquake of Shkodra of June 1905 ($M_S=6.6$; $I_0=IX$ degrees) were evidenced on a very broad space on both sides of Buna River (Koçiaj, *et.al.*, 1980) and these phenomena were repeated on the same zone from the earthquake of April 15, 1979 ($M_S=6.9$, $I_0= IX-X$ degrees). On the table below are given some data on liquefaction and other ground phenomena evidenced during some strong earthquakes in Albania (see Photo I.21, I.22, I.23).

Data on liquefaction phenomena in Albania

Earthquake	M	Intensity, I_0	Location	Evidenced phenomena
01/06/1905	6.6	IX	Trush, Bahçallëk, Tabak (Shkodër)	Subsidence of river banks on Drini and Buna River. Ground fissures accompanied by water and sand fountains.
27/12/1926	6.0	VIII-IX	Shijak, Durrës	Fountains with hot water and sand; pseudovolcanos with sand and mud.
17/8/1948	5.5	VIII	Trush, Shkoder	Ground fissures with length 30-50 cm, width 0.5 m; fountains with sand and water.
01/09/1959	6.4	VIII-IX	Kuç bridge, Çiflig, Kozare (Lushnjë, Berat)	Ground fissures with length some hundred meters and width up to 25 cm; subsidence of river banks on Seman and Osum Rivers.
18/03/1962	6.0	VIII	Rërës, Fier (Fier), Mifol, Novoselë (Vlorë)	Ground fissures with length up to 100 m and width up to 40 cm; some fountains with water and sand from the fissures.

15/04/1979	6.9	IX	Montenegro coast District of Shkodra	Intensive subsidence of ground, ground slides. Ground fissures with length 50-250 m and width 40-50 cm, accompanied by water and sand fountains; sand pseudovolcanos with diameter up to 1 m; subsidence of river banks of Drini and Buna Rivers.
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CHAPTER II

SOME FEATURES OF ACTIVITY AND ACTUAL EARTHQUAKE DISTRIBUTION IN ALBANIA *(B.Muço, E.Sulstarova, S. Koçiu, SH.Aliaj)*

Some characteristics of seismicity of Albania *(B.Muç, E.Sulstarova, S. Koçiu)*

The main cause of Albanian seismicity as is mentioned above is the confrontation of Adria with Albanian orogen. This continental collision not only influences directly on the activation of longitudinal faults on the edges of orogene and on the segments of transversal faults cutting this contact but has a tectonic implication even on the internal part of the country, on the longitudinal and transversal faults that include the eastern and northeastern part of Albania. On this respect and on the basis of earthquake distribution and seismotectonics, there are two tectonic domains in Albania: the outer domain which takes part directly on the contact Adria – orogen and inner domain which includes that part of the country eastward of the hypothetical line Shkoder – Leskovik.

Based on the most reliable instrumental and macroseismic data, with the model of macroseismic field proposed by Blake (1941) and on the statistical analysis of the data, the following relations between instrumental and macroseismic parameters are found:

$$M_S = 0.53(+0.01)I_0 + 1.46(+0.12)$$

$$I_0 = 1.97 M_S - 3.06 \log h - 0.61$$

for $h < 10$ km; $4.0 \leq M_S < 7.5$

$$I_0 = 1.75 M_S - 4.55 \log h + 3.45$$

for $h > 10$ km; $4.0 \leq M_S < 7.5$

and as an average:

$$I_0 = 2.1 M_S - 4 \log h + 0.44$$

where M_S – is the magnitude of earthquake according to surface waves; I_0 – is the intensity on epicenter according to MSK-64 scale; h – is the depth of earthquake focus on km (Sulstarova and Aliaj, 2001).

Based on the above relations, we can say that in Albania, the shocks with intensity VI, VII, VIII and IX degree (MSK-64), could be caused from the earthquakes with magnitudes respectively: $M_S \geq 4.9$; 5.5; 6.0 and 6.6.

The relationship between the intensity and local magnitude Richter, for earthquakes with $M_L \leq 5.0$, derived from the records of ASN for the period 1976-1994 is:

$$M_L = 0.47 I_0 + 1.32$$

For Albanian territory and nearby, the relation between the length of earthquake source and magnitude M_S :

$$\log L = (0.46 \pm 0.05) M_S - (1.59 \pm 0.34)$$

for $5.5 \leq M_S < 7.5$

Based on the above relation, for the range of $M_S = 6.0 - 7.0$, the length of generating fault would be between 16 and 45 km.

The well-known law of distribution of frequency of earthquakes versus magnitude: $\log N = a - bM$, where N – the number of earthquakes above a certain magnitude and a and b coefficients, is used. The coefficient b is particularly important because it is considered as seismotectonic representative of a certain region and its fluctuations are related with the seismic energy release and the preparation of relatively strong earthquakes. With the earthquake data for the years 1901-1985 it is found that for $4.6 \leq M_S < 7.5$ the above relation has the form:

$$\log N = 5.74 - 1.10 M_S$$

For the records of ASN, 1976-1992, for about 1800 earthquakes with $M_L \geq 2.5$ included in the rectangle $39-43^\circ N$; $18.5-21.5^\circ E$, is calculated the relation:

$$\log N = 6.65 + 0.99 M_L$$

For this period, it is of interest to mention that the coefficient b for the outer domain is lower ($b=0.94$) then for inner domain ($b=1.06$). The test of Fisher proves that this difference is statistically valuable at the 95 % of confidence level (Muço, 1995,b). From the new Catalogue of earthquakes of Albania, 1964-2000 (Peçi et al., 2002), the Gutenberg-Richter relation is:

$$\log N = 6.14 - 0.96 M$$

for the $M \geq 2.9$.

From the study of depth distribution of earthquake foci of Albania, it is evidenced that these foci are generally shallow, with depth at 10-20 km and in many cases till near the surface. This is true for historical earthquakes as well as for instrumental ones. From the records of ASN for the period 1976-2000, 95 percent of earthquakes have the depths that not exceed 30 km. It bears witness that the seismicity of Albania is characterized from dynamical processes that happen mainly in the earth crust, mostly on its granitic part and many seldom in the upper part of the mantle.

The typology of earthquakes in Albania comprises all three main well-known types of earthquakes: the earthquakes with main shock and aftershocks, the earthquakes with foreshocks, main shock and aftershocks, and the swarms. The seismic observations from 1976 to 1990 have given evidence that 70 percent of earthquakes with $M_L \geq 4.0$, are of first type, so they have no foreshocks but only main shock and aftershocks. From 1976 to 1990, it is found that the theoretical form of aftershock attenuation with magnitude range $3.5 \leq M_L \leq 5.5$ follows the Omori's law:

$$N = c/(1+t)^{1.131}$$

where N – aftershocks' number, t – time in day and c – a constant .

It is a difference on attenuation of aftershocks for outer and inner domain, with attenuation coefficients respectively 1.020 and 1.329, which witnesses for a faster tendency of attenuation of aftershocks in the inner domain than on outer one. It is also calculated that meanly the energy

released from aftershocks of earthquakes ($3.5 \leq M_L \leq 5.5$) it makes up 8 percent of energy of main shocks (Muço, 1995, c).

Analyzing the cumulative number of earthquakes with $M_S \geq 6.0$ occurred in Albania during two last centuries, are evidenced 6 time intervals where the seismic rate is alternated from a lower to a higher value. On this basis, it is constructed a statistical sequential model describing the seismic procedure of Albania in time. From this model it is found that the intervals of relatively low seismicity last 31-43 years and those of seismicity relatively high, 17-21 years (Muço and Puka, 1993).

Another characteristic of seismicity of Albania investigated these last years is the very active role of underground water on the generation of earthquakes. This role is more evident in the inner domain of the country. The Albanian earthquakes have the tendency to occur mostly in the rainy period of the year so October to March. The influence of water impoundment of large reservoirs in the seismicity of the area where reservoirs are constructed is a strong support of role of underground water on the seismic energy releasing (Muço, 1991; 1995,a; 1999). The sequence of earthquakes of Nikaj-Merturi, northern Albania, November 1985 – August 1986, where about 17.000 microearthquakes were recorded, is a very clear evidence of the influence of underground water on the earthquake process (Muço, 1991). The increase of the pore pressure of the groundwater under the influence of such factors as heavy rainfall, floods, reservoir impoundment etc. and the release of seismic energy not according to natural progress it is something that should be considered on the seismological panorama of the country.

The increasing of the number of seismological stations in Albania as well as in the neighbor countries influenced the growth of the earthquakes and microearthquakes recorded during the last quarter of 20th century. The new Catalogue of Albanian earthquakes for the period 1964-2000, prepared into the framework of NATO project “Seismotectonics and Seismic Hazard Assessment of Albania” (1999-2002) (Peçi et al., 2002) contains about 20.000 localized earthquakes. In this number there are 3 earthquakes with $M \geq 6.0$, 33 earthquakes with $5.0 \leq M \leq 5.9$, 555 earthquakes with $4.0 \leq M \leq 4.9$ and 3915 earthquakes with $3.0 \leq M \leq 3.9$ (FIG. 4).

The total energy released from Albanian earthquakes during the 20th century is $E = 6.448 * 10^{22}$ erg the energy that corresponds to one sole earthquake with $M=7.34$.

The focal mechanism solutions and distribution of stress field in Albania (B.Muço, E. Sulstarova)

The focal mechanism solution is a very powerful tool giving information not only for the geometry and kinematics of the tectonic faults having generated certain earthquakes but even for the tectonic stress field present in a given region.

There are a lot of studies focused on the focal mechanisms of Albanian earthquakes (Anderson and Jackson, 1987; Constandinescu et al., 1966; Delibasis and Papazachos, 1969; McKenzie, 1972; Sulstarova, 1987; Muço, 1994,a; Louvari et al., 2001). What is common from almost all the studies, is that in outer domain of Albania which comprises the contact zone between Adria microplate and Albanian orogene, a compressional stress is predominant with orientation almost perpendicular to the shoreline. In inner domain the predominance passes to an extensional stress with a NW-SE direction (Muço, 1994,a). In the Table 1 there are given the parameters of mean stress obtained by Fisher analysis for 5 zones of Albania given in FIG. .

Zo -ne	Compression	Extension	Predo
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									-min.
	Data.	Azm. (o)	Dip. (o)	Hp (o)	Data	Azm. (o)	Dip (o)	Hp (o)	
1	28	228.4	5.3	10.9	24	164.6	6.0	12.9	Comp
2	22	245.9	12.8	11.9	17	358.3	0.5	14.2	Comp
3	31	249.1	10.7	11.9	22	161.7	7.0	11.4	Comp
4	21	181.2	6.6	13.6	26	120.4	6.5	11.9	Ext.
5	8	166.1	7.4	13.4	10	308.7	4.7	13.4	Ext.

CHAPTER III

NEOTECTONIC STRUCTURE AND SEISMOACTIVE FAULTS (*Sh.Aliaj*)

Neotectonic structure

The orogen in Albania and its surroundings are divided into two domains with different present-day tectonics: an external compressional domain, constituting the Adriatic collision zone, and the internal extensional domain. The external tectonic zones (Sazani, Ionian and Kruja ones), which make up the orogenic fronts in the Adriatic collision zone, constitute deformed sedimentary cover thrust towards the south-west (Aliaj, 1997). The rapidly subsiding Periadriatic foredeep developed in front of these advancing external thrust sheets. The neotectonic geomorphology of the interior of the country has a horst-graben arrangement due to Pliocene-Quaternary normal faulting, while in the external domain it is mountainous, except for the Periadriatic Depression.

The present-day tectonic stress field has been well studied via microtectonics (Aliaj, 1988) and focal mechanism solutions of earthquakes (Sulstarova, 1986; Muço, 1994, 2007). In external domain the average axis of compression is of NE-SW direction (average azimuth 225°), while in internal domain the average axis of extension is of NNW-SSE (average azimuth 340°) (Aliaj, 1988; Sulstarova, 1986).

Four large neotectonic units have been recognized in Albania based on the sense, intensity and chronology of vertical movements (Aliaj, 1998), as follows (Figure 3.1):

1. Internal Alpine unit affected by post-Pliocene extensional tectonic.
2. External Alpine unit strongly affected by pre-Pliocene compression
3. Periadriatic Foredeep strongly affected by post-Pliocene compression
4. Foreland in Adriatic and Ionian offshore

The internal Alpine unit comprises terrains east of the Kruja Zone. This unit was affected by strong extension during the Pliocene to Quaternary, which resulted in horst-graben structures

and topography. As a consequence, new lake basins have been formed within the grabens and horsts and associated block mountain fronts, and continue forming today (Aliaj, 1998). The horst-graben morpho-structural ensemble arose as the horst mountain blocks underwent relative uplift; the highest peaks in this region now reach elevations between 2,000 and 2,800 m

The external unit includes the regions of Kruja, Ionian and Sazani zones up to the offshore. The Kruja Zone is made up of Cretaceous-Eocene platform carbonates and Oligocene flysch, the Ionian Zone - of Mesozoic-Eocene basinal carbonates and Oligocene-Lower Miocene flysch, and the Sazani Zone - of Cretaceous-Paleogene platform carbonates (Figure 3.4, 3.5). These regions have been strongly deformed by folds, reverse faults, including both thrusts and occasional back-thrusts, as well as by strike-slip faults; all faults are inherited from the main Alpine compressive phases. Compressional deformation continues to the present. The shortening from cross-sections in Ionian Zone of Southern Albania is estimated from 45 % (Aliaj et al., 1989) up to 100% (Bega et al., 2003). Active crustal shortening along the western coast of former Yugoslavia, Albania and Greece occurs at about 2 mm/yr (Papazachos et al., 1992).

The Periadriatic foredeep includes the hills and plains of the western lowlands of Albania, and molasse sediments, which accumulated from the Middle Miocene to the end of Pliocene. The Periadriatic foredeep is located west of the external area, between the Shkodra-Peja fault and the Vlora-Tepelena transverse flexure. West of the Periadriatic depression, the foreland extends into offshore. The Periadriatic depression is regarded as a foredeep because it is located over the outer (western) margin of the Albanian orogen, and records a rearrangement of structural styles.

The offshore foreland is situated west of the Periadriatic foredeep and Sazani zone, as well as west of the Ionian zone south of the Othoni Island-Dhermi transform fault (Figure 3.1). In the offshore foreland, two different carbonate facies have been distinguished (Aliaj, 1998):

- a) The offshore foreland with basinal carbonates of pre-Oligocene age has been named the Albanian Basin or South Adriatic Basin and has not been affected by deformation (Figure 3.5, 3.6), and
- b) The foreland with platform carbonates of Upper Triassic-Oligocene age, termed the Apulian platform, has been weakly deformed by normal faulting.

Based on the oil and gas seismic explorations carried out last 15 years by foreign companies, the convergent boundary between the Albanian orogen and the Adria microplate is now well constrained to be located in the Ionian and Adriatic offshore.

In Albania and Greece, along the southern convergent margins of the Eurasia plate, we distinguish a northern segment, belonging to the Adriatic continental collision, and a southern one, belonging to the Aegean (Hellenic) Arc related to active oceanic subduction. The boundary between the Aegean Arc and the Adriatic collision is the Cephalonia Transform Fault (Figure 3.8). Numerous data on focal mechanism solution of shallow earthquakes show that horizontal compression (thrust faulting) dominates along the Adriatic collision as well as along the SW-convex edge of the Hellenic Arc, while extension dominates behind them (Sulstarova, 1986; Muço, 1994; Papazachos & Papazachos, 1989).

The Albanian orogenic thrust front is cut and displaced by the Othoni Island-Dhermi, the north of Sazani Island, and the Gjiri i Drinit-Lezha strike-slip faults, which divide the orogen into separate segments showing diachronous development (Aliaj, 1998, 2004, 2006). The following segments of the orogenic thrust front of the Albania orogen have been recognized (Aliaj, 2006):

1. The NW-trending Lefkas-Corfu offshore segment
2. The NW-trending Karaburuni-Sazani Island offshore
3. The ~N-trending Frakulla-Durresi mainly onshore segment
4. The W-NW-trending Lezha-Ulqini offshore segment.

Active fault zones in Albania

Identification of active faults is a very important step in seismotectonic analysis, requiring a good definition of seismic sources, i.e. of active faults along which the earthquakes occur. The earthquake epicenters in Albania are concentrated mostly along active faults or fault zones (Aliaj, 2000).

The mapped active faults in Albania were determined by different studies, such as geological, geomorphological and geophysical (mainly seismic) investigations. The offshore faults are identified from recent seismic explorations carried out in Albanian offshore by foreign companies (Aliaj, 2000).

The active structural elements are represented on the map of active faults in Albania by the type of deformation (normal fault, reverse fault, thrust and back-thrust, strike-slip, flexure, diapir evaporite dome) and their chronology of activity.

Three longitudinal and two transverse active fault zones are evidenced into the Albanian orogen, as follows:

1. The Ionian-Adriatic thrust fault zone, NW up to nearly NNW trending
2. The Shkodra-Mati-Librazhdi graben fault zone, NW trending
3. The Peshkopi-Korça graben fault zone, N-S trending
4. The Shkodra-Tropoja normal fault zone, NE trending
5. The Elbasani-Dibra normal fault zone, NE trending (Aliaj, 2000)

SECOND PART: SEISMIC HAZARD OF ALBANIA

CHAPTER I

The history of seismic hazard evaluation in Albania (B.Muço)

The lack of strong motion data for a prone-earthquake country like Albanian has been a real handicap in the development of complete seismic hazard analyses and practice of anti-seismic construction design. Nevertheless, the collection, cataloguing and mapping of historical earthquakes as well as seismic monitoring during three last decades of 20-th century have provided a huge and sufficient information on distribution of earthquake epicenters in Albania helping for identification of active faults (Sulstarova etj. 1980, Muço, 1995, 1998; Peçi *et al.*, 2001). The first seismic map of Albania compiled by specialist of former Institute of Sciences and Ministry of Construction in 1952 on the scale 1:850,000 based mostly on the study of Moreli (1942). This map has been part of technical code on anti-seismic routine construction in Albania.

First scientific study on evaluation of seismic hazard of Albania, "Map of Seismic Zonation of PR of Albania in the scale 1: 2,500,000" has been completed on 1971 into the framework of compiling the Seismic Map of Europe in the scale 1:5,000,000. A methodology created from experts of Seismological European Commission was used for Albanian map which

together with respective text has been included in the Seismic Map of Europe (Sulstarova, etj. 1971).

In 1972 the study "Seismic Map of PR of Albania in the scale 1: 1,250,000" (Sulstarova, etj. 1972) has been also published being a basis for design of construction of main structures of the country.

In both above-mentioned the maximum expected intensity for mean soil conditions were expressed in degree of MSK-1964 scale.

In 1979 comes the study "Seismic Zonation of PSR of Albania" together respective map (Sulstarova, etj, 1980) which has been endorsed from Council of Ministers and used since that time as integral part of technical codes of design of anti-seismic construction. According to the seismic zoning map of Albania of the year 1980 (Sulstarova et al. 1980) all the territory of Albania is divided into three main zones with basic intensity of shaking VIII, VII and VI degree of MSK-64 scale, for average soil condition. In some small parts, due to poor soil conditions, the seismic intensity may attain up to IX degree of intensity (Sulstarova et al., 1980; Sulstarova and Aliaj, 2001, a).

Some maps on probabilitary distribution of return period of seismic intensity based on the parameters obtained using first and third Gumbel distribution were also produced prior to 1990 (Koçiu, 2000).

In the 90' with theoretical development of seismic hazard (McGuire, 1976, Algermissen and Perkins, 1976) and growing computer feasibilities, a series of seismic hazard analyses were carried out in Albania using both deterministic and probabilistic approach.

In collaboration with the Department of Earth Sciences of University of Trieste, Italy and into the framework of NATO project "Seismotectonics and seismic hazard of Albania" the first assessment of seismic hazard of Albania through the deterministic approach has been realized in 1998 (Muço *et al.*, 2001, 2002).

On the years 1999-2003, into the framework of the same NATO project and in collaboration with Geophysical Department of Aristotle University of Thessaloniki, Greece, has been completed for the first time a fulsome analysis of seismic hazard of the country using the probabilistic (Muco etj., 2002; Kiratzi dhe Muco, 2004). In this analysis the module OHAZ (Lapajne et al. 1997 a, 1997 b, 2000; Poljak et al., 2000) produced by Geophysic Survey of Slovenia has been used for hazard calculation. According to this analysis the zone with PGA (0.24 – 0.28 g) covers 1.6 % of Albanian territory, the zone with PGA (0.20 – 0.24 g), 7.2 % of territory, the zone with PGA (0.16 – 0.20 g), 32.4 % of territory, the zone with PGA (0.12 – 0.16 g), 47.5 % of territory and the zone with PGA (0.08 – 0.12 g), 11.3 % of territory. The highest PGA values are concentrated along the Albanian orogen thrust front, precisely in the Montenegro-Albania border region, in the zone of Vlora and Tepelena, and in the southwestern part of the country (Muco etj., 2002; Kiratzi dhe Muco, 2004).

A similar analysis with the same modul completed in 2003 (Kuka etj., 2003, Duni dhe Kuka, 2004). Accordig to this study, the highest PGA values rezult over 0.3 g and concentrated in border region Montenegro-Albania and Vlora-Tepelena (Kuka etj., 2003, Duni dhe Kuka, 2004).

Into the framework of a collaboration with the Office of Seismic Haard of Geological Survey, Ottava, Kanada, has been completed another analysis of seismic probability hazard analysis the FRISK88 of Risk Engineering Inc. (Aliaj etj., 2004). Besides PGA values in this analysis are obtained spectral accelerations (SA) for various periodes as well of uniform seismic hazard for some of Albanian cities.

DETERMINISTIC HAZARD (B.Muço)

Method and results

The procedure adopted for the seismic zonation of Albania is deterministic, developed by Costa et al. (1993), based on the computation of synthetic seismograms generated by the modal summation technique (Panza, 1985; Panza and Suhadolc, 1987; Florsch et al., 1991; Panza et al., 2001). This approach has been already used to produce hazard maps for the Circum-Mediterranean region (Panza et al., 1996, 1999; Orozova-Stanishkova et al., 1996, Aoudia et al., 2000; Bus et al., 2000; El-Sayed et al., 2000; Markusic et al., 2000; Radulian et al., 2000; Zivcic et al., 2000) and for Eastern Cuba (Alvarez et al., 1999).

The Albanian territory has been subdivided into $0.2^\circ - 0.2^\circ$ cells. Each cell belonging to seismogenic zones has been assigned the magnitude value of the strongest event that occurred within it. Through the application of a centred smoothing window (Panza et al. 1999), the maximum magnitude of each cell has been associated to the surroundings cells, in order to partly account for source dimensions, for catalogue incompleteness and localization errors in epicentral coordinates. A double-couple point source is placed in the centre of each cell. In our case, as will be explained below, for each seismogenic zone only a single representative focal mechanism is used.

Placing the receivers at the vertices of the $0.2^\circ - 0.2^\circ$ cells, and having already defined the structures and sources, the synthetic seismograms are computed by the modal summation technique. All seismograms have been generated for a constant hypocentral depth, fixed at 10 km, and with a cut-off frequency of 1 Hz. The radial and transverse components of motion are computed for a seismic moment of 1×10^{-7} Nm, and then the amplitudes are properly scaled according to the moment – magnitude relation given by Kanamori (1977) and the spectral scaling law proposed by Gusev (1983) as reported in Aki (1987). At each site, the horizontal components are firstly rotated to a reference system common to the whole territory (north-south and east-west direction) and then the resultant vector is computed. The maximum value of the analysed parameter (e.g. displacement, velocity or acceleration) has been selected and plotted on the map. The deterministic results may be extended to higher frequencies by using design response spectra (Panza et al., 1996), for instance Eurocode 8 (EC8, 1993), which define the normalized elastic acceleration response spectrum of the ground motion, for 5 % critical damping. In general, this operation should be made taking into account the soil type. For Albania, the adopted structural models are of type A, as defined in EC8, therefore we can immediately determine the Design Ground Acceleration (DGA) using the EC8 parameters for soil A (Panza et al., 1999).

A revised file of earthquakes with $M > 4.5$ which occurred in Albania and nearby since the beginning of first millennium, was prepared at the Seismological Institute of Tirana for the purpose of seismic hazard assessment of the country (Sulstarova et al., 2000). This file is based on the Catalogue of Earthquakes of Albania (Sulstarova and Kocijaj, 1975) and all the available catalogues containing the earthquakes of Albania (Shebalin et al., 1974; Makropoulos and Burton, 1981; Guidoboni et al., 1994; Karnik, 1996; Papazachos and Papazachou, 1997). The area covered by this catalogue is bounded by the co-ordinates: $39.0^\circ - 43.0^\circ$ N and $18.5^\circ - 21.5^\circ$ E. The magnitudes for historical earthquakes are based on intensity information using the correlation formula $I_0 = 1.5 M_S -$

0.986 (Sulstarova and Koçiaj, 1975). The catalogue file employed in this study contains about 500 earthquakes with $M \geq 4.5$, for the time period from 1 to 1995.

For historical earthquakes with epicentres in Greece, the coordinates and magnitude values given by Papazachos and Papazachou (1997) are used. For the events with epicenter in Yugoslavia or Republic of Macedonia, the Catalogue of Balkan (Shebalin et al., 1974) is consulted. In the case of Montenegro earthquake of April 15, 1979, the magnitude 6.9 is assigned according to Catalogue of Europe and the Mediterranean (Karnik, 1996). In order to determine the parameters of the Gutenberg – Richter relation for the data of this file, the ZMAP software (Wiemer, 2001) has been used. As one can see from this FIG.5,b, with the accepted regression, the number of earthquakes of magnitude 7 is lower than could be expected from the regression of all the earthquake data. This can be due to the small territory considered when the fault dimensions for an earthquake of $M = 7$ are of 50-70 km (Molchan et al., 1999). Another explanation is that the lack of earthquakes with magnitude under 5.0 shifts the regression leaving down the number of earthquakes of $M = 7$. Figure 5,a where the cumulative number of earthquakes with $M \geq 6$ versus time is given, shows that we cannot consider our catalogue complete for magnitude threshold of 6, at least before the XVII century.

The results of our computations using the velocity model M1 are shown in FIG. 9. The DGA values for Albania are in the range of 68 to 311 cm/sec^2 . The area with the largest values is a small one in the very south of Albania, at the border with Greece (DGA over 300 cm/sec^2). The second zone covers 80 % of Albanian territory (DGA between 150 and 300 cm/sec^2). The third zone (DGA between 80 and 150 cm/sec^2) is distributed throughout the Albanian territory, from north to south. The last zone is continued in the northernmost part of Albania (DGA between 40 and 80 cm/sec^2).

The velocity values (FIG. 9b) can be separated mostly in two zones, the first one (V between 15 and 27.1 cm/sec) covers most of the south and southeast part of Albania and the second (V between 8 and 15 cm/sec) covers most of the central and northern part of the country. Some small spots with V between 4 to 8 cm/sec in the northern part of Albania have been also obtained. As for the displacement (FIG. 9c), one can separate two zones: one in the very south of Albania, in eastern part and in northwestern part (D between 7 and 9.7 cm) and another in more than 80 % of the Albanian territory (D between 3.5 and 7 cm).

CHAPTER II

PROBABILISTIC HAZARD (*Sh.Aliaj, B.Muço, E.Sulstarova*)

Methodology of probabilistic approach (*Sh.Aliaj, B. Muço*)

For the seismic hazard analysis a probabilistic method referred to as PSHA - probabilistic seismic hazard analysis was used for Albania. A PSHA determines the frequency (the number of events per unit of time) with which a seismic hazard (i.e. an earthquake that can cause damage and loss) will occur (McGuire, 2004).

The probabilistic approach of seismic hazard analysis, which was initiated by Cornell (1968), is performed by a two-step methodology: the first - seismotectonic step involves

identification of seismic source zones, while the second- engineering step is concerned with the calculation of the seismic effect caused by these at the surface.

The PSHA technique uses the widest possible amount of data, combining seismological, geological and geophysical data to build up a model of the earthquake-producing processes.

The basic elements of modern probabilistic seismic hazard assessment can be grouped into four main categories, as follows (McGuire, 1993):

1. Earthquake catalogues: Compilation of seismicity catalogues for historical (pre-1900) and instrumental periods.
2. Earthquake source zone characterization: Identification of seismic source zone's model and their seismicity parameters.
3. Strong seismic ground motion: Selection of attenuation relationships or "ground motion prediction equations" to estimate ground motion intensity.
4. Computation of seismic hazard: Probability analysis (determines the annual frequency of exceedance of the ground motion intensity parameter [e.g. PGA, PGV, SA]) of interest).

According to McGuire, 1993 methods for seismic hazard calculation can be divided into two categories:

The first type method ("historic method") is based on clusters of historical seismicity alone and does not use fault and seismic source data or seismicity parameters. Thus the historic method requires only a catalogue of historical earthquakes, appropriate attenuation functions for ground motions in the region, and site response functions.

The second type method ("deductive method") relates to fault sources (i.e. individual faults, zones comprising multiple faults or regions of faulting) and areas of high local shear stress for which the features causing earthquakes and their characteristics (the seismicity parameters) have been identified in a deductive investigation/interpretation process. Such a process is e.g. based on geologic, geophysical, and instrumental, historical, prehistorical data, and in recent years, paleoseismicity data. Important source characteristics are e.g. the mode of fault rupture, fault length, fault segmentation coupling of the individual fault segments, the dynamics of the fault rupture, and the physical dimensions of the fault rupture surface. The deductive method of seismic hazard analysis was first published by Cornell (1968), and has been widely used since this time.

The hazard analysis was done by the application of the Cornell-McGuire methodology (Cornell, 1968, 1971; McGuire, 1976) using the EZ-FRISK 7.12 hazard code (EZ-FRISK 7.12 is a proprietary software product of Risk Engineering Inc., U.S.A), which allows explicit inclusion of aleatory uncertainty. Cornell-McGuire approach included the aleatory uncertainty by incorporating the "sigma" of the ground motion relations into the computation. EZ-FRISK software program lacks the treatment of epistemic uncertainty.

EZ-FRISK is a software package used by engineers and seismologists to perform site specific earthquake hazard analysis. EZ-FRISK contains a large number of programmed attenuation equations along with their coefficients.

Moreover this software product permits to do calculations for two levels of probability in accordance with Eurocode 8: i.e. (i) 10% in 50 years (475 years return period) and (ii) 10% in 10 years (95 years return period).

Basic elements for assessment of probabilistic seismic hazard

The basic four steps involved in probabilistic seismic hazard assessment for Albania are described below.

Earthquake catalogue (E.Sulstarova, B.Muço, S.Koçiu)

The work for seismic hazard assessment of Albania was carried out through giving the main features of its seismicity, as follows:

- Earthquake catalogues for historical and instrumental seismicity,
- A short description of the major earthquakes with their isoseismal maps,
- A short description of macroseismic field with its map of the observed maximum intensities in MSK-1964 scale.

The earthquake catalogues of the Albanian earthquakes for historical and instrumental periods constitute the fundamental data for characterization of seismicity.

For the seismic events we used the revised catalogue of Albanian earthquakes (Sulstarova et al., 2005a), including earthquakes with magnitude $M_s \geq 4.5$ that were registered in the region between 39.0° N and 43.0° N and 18.5° E and 21.5° E between the period of 58 and 2005 A. D. This file was prepared by experts of the Seismological Institute of Tirana with the intention to provide a sound basis for seismic hazard assessment on Albanian territory. The file is based on the “Catalogue of Earthquakes of Albania” (Sulstarova and Koçiaj, 1975) and all further catalogues available, which account of earthquakes registered on Albanian territory (details see Shebalin et al., 1974; Makropoulos and Burton, 1981; Karnik, 1996; Papazachos and Papazachou, 1997). The magnitudes for historical earthquakes are based on intensity information using the correlation formula $I_0 = 1.5 M_s - 0.986$ (Sulstarova and Koçiaj, 1975). For the time period 1901-2005 the used magnitude is also M_s . The catalogue file employed in this study contains about 552 earthquakes with $M \geq 4.5$, for the time period from 58 to 2005 (Sulstarova, Muço and Koçiu, 2005a) (see Figure 1).

The fore and aftershocks were removed from the used Albanian catalog 58-2005, that it is the main input for hazard calculation. In order to distinguish independent events from foreshocks and aftershocks three criteria are used: inter-event time, location, and size of the event. Using a space-time magnitude dependent window, we identified independent events and removed aftershocks and foreshocks from the sample.

An analysis of completeness of the catalogue was performed by using the cumulative number versus time curves in order to evidence slope changes, assuming that the most recent change in slope occurs when the data became complete for magnitudes above the reference (Gasparini et al., 2000). The cumulative number versus time curves show, for four magnitude intervals, the point in time from when the data is assumed to be complete. It is obvious that the catalogue can be considered complete for $M_s \geq 4.5$ since 1920, for $M_s \geq 5.0$ since 1890, for $M_s \geq 5.5$ since 1850 and $M_s \geq 6.0$ since at least 1550.

Characterization of seismic source zones and their parameters of the seismicity (Sh.Aliaj, E.Sulstarova, B.Muço)

One of the basic elements of modern probabilistic approach for seismic hazard assessment is the earthquake source characterization, to define the master seismic source model, using evidence from earthquake catalogues, active faults and present-day tectonic regime.

Special attention was dedicated to seismotectonic analysis and synthesis in all generalized studies on seismicity of Albania (Sulstarova et al., 1980; Aliaj, 1988, 2003; Sulstarova & Aliaj, 2001; Sulstarova et al., 2003; Muço et al., 2004; Aliaj et al., 2004).

Albania is one of the most seismically active countries in Europe. Most strong earthquakes occur in 3 well-defined seismic belts:

- a) The Ionian-Adriatic coastal earthquake belt at the eastern margin of the Adria microplate, which trends northwest-southeast;
- b) The Peshkopi-Korça earthquake belt, which trends north-south, and
- c) The Elbasani-Dibra earthquake belt, which trends north-easterly (Sulstarova et al., 1980; Aliaj, 2003).

The earthquake epicenters are concentrated mostly along active faults or fault zones (Aliaj, 2000b).

Delineation of seismic source zones is a fundamental step in probabilistic earthquake hazard analysis. A description of future earthquakes is based on a combination of the knowledge of the past earthquakes and of the geological features (active faults) along which they occurred.

A master seismicity source model for Albania describes the spatial-temporal distribution of the earthquakes, using evidence from earthquake catalogue, seismotectonics, active faults and geodynamic models. Seismic source zones are defined as area that share common seismological and neotectonic attributes and are determined with two fundamental tools: a seismicity profile and the present-day tectonic regime of the region under consideration. This definition implies that seismicity in a seismic source zone is uniformly distributed throughout the zone and the future earthquakes may occur everywhere in the zone. The maximum magnitude for each zone has been determined considering the size of past earthquakes and tectonic reasonableness of large earthquakes.

Four seismotectonic models for Albania have been determined last twenty years, as follows:

1. First earthquake source model by Aliaj, 1988, represented by 6 seismogenic zones;
2. Second earthquake source model by Sulstarova & Aliaj, 2001 with small improvements by Aliaj, 2003, represented by 8 seismic source zones;
3. Third earthquake source model by Aliaj et al., 2004, represented by 10 seismic source zones;
4. Fourth earthquake source model by Sulstarova, Aliaj and Muço, 2005, represented by 9 seismic source zones.

The last seismotectonic model (Sulstarova et al., 2005b) will be used for seismic hazard assessment of Albania.

The Used Seismotectonic Model (Sh. Aliaj, E. Sulstarova)

From the considerations of present-day tectonic regime, the subset of the Albanian catalogue, the regional seismicity was divided into 9 seismic sources (Sulstarova et al., 2005b), which includes some redefinition of 8 zones previously discussed for Albania (Sulstarova and Aliaj, 2001; Aliaj, 2003) together with a source zone to model earthquakes in the Skopje region (Talaganov et al., 2003).

So, 9 newly defined seismic source zones distinguished in Albania and its surroundings are following:

1. Lezha-Ulqini (LU) zone with $M_{max}=7.2$
2. Peri-Adriatic Lowland (PL) zone with $M_{max}=7.0$

3. Ionian Coast (IC) zone with $M_{max}=7.0$
4. Ohrid-Korça seismic (KO) source zone with $M_{max}=6.9$
5. Elbasani-Dibra-Tetova (EDT) zone with $M_{max}=6.8$
6. Kukesi-Peshkopi (KP) zone with $M_{max}=6.5$
7. Shkodra-Tropoja (ST) zone with $M_{max}=6.5$
8. Peja-Prizreni (PP) zone with $M_{max}=6.8$
9. Skopje (SK) zone with $M_{max}=6.5$

Seismicity Parameters (B.Muço)

The estimation of the seismicity parameters (i.e. the maximum earthquake magnitude, M_{max} , for a given source zone and the relative frequency of occurrence of earthquakes within a source zone as a function of magnitude) was performed by making use of 2 different methods:

- (i) The classical Gutenberg & Richter method
- (ii) The Kijko & Sellevoll method

Considering that the seismicity data for this study are incomplete for the period between 58–2000 A.D. and the uncertainties concerning to the location of the earthquake epicentres the Kijko-Sellevoll method (Kijko and Sellevoll, 1992; Kijko and Graham, 1998) was applied for seismicity parameter determination. The Kijko-Sellevoll method has the great advantage to accept the mixing of seismicity data sets of different quality (e.g. of a data-set containing only the largest earthquakes, and of a second one, which is complete from a various magnitude upwards).

M_{max} was estimated by the application of a *Bayesian* model and the usage of computer code NH2.FOR (Council of Geosciences, Geological Service of South Africa, Pretoria, South Africa). For each seismic source zone incomplete seismic and complete catalogue data were used for estimation of M_{max} as well as β and activity rate (λ) The results obtained from this procedure are shown in two tables below (Muço, 2002).

Table 1: Seismicity parameters for Albania

Seismicity parameter	Contribution of extreme values	Contribution of complete catalogue
$\beta = 2.01 \pm 0.17$ ($b=0.87 \pm 0.07$)	76.41%	23.6 %
$\lambda = 0.76 \pm 0.16$ (for $M_{s-min}=4.5$)	29.6 %	70.4 %
$M_{s-max} = 7.25 \pm 0.25$		

$B = [\beta = b * \ln 10$, where b is the Gutenberg-Richter relation parameter] and $\lambda =$ Activity Rate [$\lambda =$ The number of events per year having magnitudes equal or greater than M_{min} on the source]

Table 2: Earthquake return periods for different magnitudes using Kijko –Sellevoll approach

M_s	Lambda (λ)	B	Probability (%)			
			1	50	100	1000

M_s	Lambda (λ)	B	Probability (%)			
			1	50	100	1000
4.5	.754E+00	1.3 (1.1 – 1.7)	0.9946	1.000	1.000	1.000
4.6	.621E+00	1.6 (1.3 – 2.1)	0.8690	1.000	1.000	1.000
4.7	.508E+00	2.0 (1.6 – 2.5)	0.7475	1.000	1.000	1.000
4.8	.415E+00	2.4 (2.0 – 3.1)	0.6376	1.000	1.000	1.000
4.9	.339E+00	3.0 (2.4 – 3.8)	0.5392	1.000	1.000	1.000
5.0	.276E+00	3.6 (3.0 – 4.6)	0.4533	0.999	1.000	1.000
5.1	.225E+00	4.4 (3.6 – 5.7)	0.3789	0.999	1.000	1.000
5.2	.184E+00	5.4 (4.5 – 6.9)	0.3152	0.999	1.000	1.000
5.3	.150E+00	6.7 (5.5 – 8.5)	0.2611	0.999	1.000	1.000
5.4	.122E+00	8.2 (6.7 -10.5)	0.2155	0.997	0.999	1.000
5.5	.992E-01	10.1 (8.3 -12.9)	0.1772	0.992	0.999	1.000
5.6	.806E-01	12.4 (10.2 - 15.8)	0.1453	0.982	0.999	1.000
5.7	.653E-01	15.3 (12.6 - 19.5)	0.1187	0.961	0.998	1.000
5.8	.529E-01	18.9 (15.6 - 24.1)	0.0967	0.928	0.994	1.000
5.9	.427E-01	23.4 (19.3 - 29.9)	0.0784	0.881	0.986	1.000
6.0	.344E-01	29.1 (23.9 - 37.1)	0.0634	0.820	0.967	1.000
6.1	.276E-01	36.3 (29.9 - 46.3)	0.0510	0.747	0.936	1.000
6.2	.220E-01	45.5 (37.4 - 58.0)	0.0400	0.666	0.889	1.000
6.3	.174E-01	57.4 (47.2 - 73.2)	0.0324	0.581	0.824	1.000
6.4	.137E-01	73.0 (60.0 - 93.1)	0.0255	0.495	0.745	0.999
6.5	.107E-01	93.9 (77.2 -119.7)	0.0198	0.412	0.655	0.999
6.6	.816E-02	122.5 (100.8-156.2)	0.0154	0.335	0.557	0.999
6.7	.612E-02	163.3 (134.3-208.3)	0.0114	0.263	0.457	0.997
6.8	.446E-02	224.4 (184.6-286.2)	0.0083	0.199	0.359	0.988
6.9	.309E-02	323.3 (266.0-412.3)	0.0057	0.143	0.266	0.954
7.0	.198E-02	505.6 (415.9-644.7)	0.0037	0.094	0.179	0.861
7.1	.107E-02	938.1 (771.6-1196.2)	0.0020	0.051	0.101	0.655
7.2	.320E-03	3122.7 (2568.5-3981.8)	0.0006	0.015	0.031	0.274

From this table one can e.g. see that an earthquake of magnitude $M_s=4.9$ has a recurrence interval of 3 year, and that an earthquake of $M_s=5.5$ features a recurrence interval of 10 years, an earthquake of $M_s=6.0$ has a recurrence interval of 30 years and an earthquake of $M_s=6.5$ could recur every 95 years while an earthquake of $M_s=7.0$ could be repeated every 500 years.

From the probabilistic point of view we should expect an earthquake of up to $M_s=4.7$ in Albania every year (75% probability). Moreover one earthquake of up to $M_s=6.1$ should be expected in Albania within a 50 years period (75% probability) respectively each century an earthquake of up to $M_s=6.4$ should be expected (75 % probability).

Zone Code	Seismicity record period (years from to)	Time period (years in total)	Earthquake number $M_s \geq 4.5$	Magnitude range	Maximum Magnitude (M_s -max)	Activity Rate (λ)	β
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IC	358-2003	1645	211	4.5-6.6	6.83±0.16	0.24±0.08	1.29±0.027
PL	58-1988	1930	108	4.5-6.6	6.81±0.18	0.20±0.09	1.26±0.032
LU	1559-1990	431	74	4.5-7.2	7.29±0.24	0.32±0.08	1.40±0.041
KO	1860-2004	144	59	4.5-6.7	6.92±0.25	0.20±0.10	1.56±0.038
EDT	1380-1998	618	53	4.5-6.6	6.72±0.25	0.22±0.12	1.22±0.042
KP	1921-1998	77	27	4.5-6.0	6.20±0.23	0.12±0.08	1.98±0.056
ST	1905-1985	80	5	4.5-5.5	5.7 (?)	0.075±0.3	0.78±0.069
PP	1456-1950	494	7	4.5-6.6	6.8 (?)	0.014±0.01	0.80±0.06
SK	518-2002	1484	8	4.5-7.2	7.2 (?)	0.005±0.03	0.53±0.08

Table 3: Parameters of source zones using Kijko-Sellevoll approach

Apart from the values obtained by the application of the Kijko-Selevoll method, the following assumptions derived from the third Gumbel distribution (Koçiu, 2005) were taken into considerations to estimate the M_{max} values of the seismic source zones. Moreover estimates for the upper-bound magnitude were made for each source zone by considering the following data: (i) the largest observed earthquake in the zone, (ii) the size of historical Albanian earthquakes in related seismic belts and (iii) the tectonic reasonableness of large earthquakes. Moreover the largest known earthquakes that occurred in similar tectonic environments were considered for M_{max} estimates. For certain source zones like the Peja-Prizreni, Ohrid-Korça and Elbasani-Dibra-Tetova seismic source zones we considered M_{max} values, which are 0.2 units larger than the largest historical event registered. The M_{max} values 0.5 and 1.0 units larger than the largest registered event for Kukës-Peshkopi and Shkodër-Tropoje seismic source zones, respectively, are taken from similar tectonic environment with the respective Korça-Ohrid and Elbasan-Diber-Tetova seismic source zones.

The M_{max} value for Skopje source zone is taken that given from Talaganov et al., 2003 ($M_{max}=6.5$), although the magnitude of earthquake of year 518 has $M=7.2$ in the Albanian catalogue, and $M=6.8$ in the catalogue of Papazachos (Greece) et al., 1989.

Earthquake depth values taken into consideration for each source zone are depth values given in the Atlas of Isoseismal Maps for Shallow Earthquakes in Albania and Surroundings for the time period 1851-1990 (Papazachos et al., 2001). Focal depth values are varying from 5 to 18 km.

The parameters of seismic source zones in Albania that are used for hazard calculation are given in 4.

Table 4: The seismic source zones parameters used for hazard calculation

Zone name/ Code	Surface (km ²)	Number of Earthquakes $M_s \geq 4.5$	Depth (km)		Maximum Magnitude ($M_s - max$)	Activity Rate (λ)	B
			Min.	Max			
Lezha-Ulqini (LU)	5140	74	5	15	7.2	0.32	1.40
Peri-Adriatic Lowland (PL)	7460	108	5	20	7.0	0.2	1.26
Ionian Coast (IC)	16600	211	5	15	7.0	0.24	1.29

Korça-Ohrid (KO)	5900	59	5	20	6.9	0.2	1.56
Elbasani-Dibra-Tetova (EDT)	2660	53	5	15	6.9	0.22	1.22
Kukësi-Peshkopi (KP)	2352	27	5	20	6.5	0.12	1.98
Shkodra-Tropoja (ST)	1570	5	5	20	6.5	0.075	0.78
Peja-Prizreni (PP)	1740	7	5	10	6.8	0.014	0.80
Skopje (SK)	3300	8	5	10	6.5	0.005	0.53

Main Characteristics of Seismic Source Zones (*Sh.Aliaj, E.Sulstarova*)

1. Lezha-Ulqini (LU) is a coastal zone comprising pre-Pliocene WNW-striking pure-compression thrust faults that parallel the Dalmatian coastal offshore line. The thrust faults are cut across by rare ENE-trending strike-slip faults.

The pre-Pliocene thrust faults are still active and seismogenic. Hence, along and near them, numerous strong earthquakes have been recorded. Among them may be mentioned the following: January 13, 1563 Ms=6.9; July 25, 1608 Ms=7.2; April 6, 1667 Ms=7.2; September 21, 1780 Ms= 6.6; June 1, 1905 Ms=6.6; April 15, 1979 Ms=6.9 (Sulstarova et al., 2005, Papazachos & Papazachos, 1989).

Focal mechanism solution of April 15, 1979 earthquake demonstrates that this fault zone is now in compressional regime with a SW-NE trend (Sulstarova, 1986; Muço, 1994). So, the future earthquakes in the Lezha-Ulqini zone may be occurred with Mmax=7.2.

2. Peri-Adriatic Lowland (PL) is a coastal zone comprising post-Pliocene oblique compression thrust faults, N to NNW-striking, which are cut by rare ENE-trending strike-slips faults.

Along the Peri-Adriatic Lowland thrust fault zone, numerous strong earthquakes have been recorded, as follows: March 1273 Ms=6.6; October 17, 1851 Ms=6.6; December 17, 1926 Ms=6.2; September 1, 1959 Ms=6.2; March 18, 1962 Ms= 6.0 (Sulstarova et al., 2005).

Microtectonic studies and focal mechanism solutions of the earthquakes demonstrate that this fault zone is now in oblique compressional regime (Aliaj, 1988; Sulstarova, 1986; Muço, 1994). Future earthquakes in the Peri-Adriatic Lowland may occur with Mmax=7.0.

3. Ionian Coast (IC) is a coastal zone containing pre-Pliocene NW-striking pure-compression thrust faults, which are cut by rare strike-slip faults.

This fault zone is still active and seismogenic. Numerous strong earthquakes have been recorded along it, among them may be mentioned the following: 358 Ms=6.6; 1153 Ms=6.6; April 16, 1601 Ms= 6.6; January 1, 1674 Ms= 6.6; April 5, 1701 Ms= 6.6; February 20, 1743 Ms=7.0; December 10, 1813 Ms=6.6; June 19, 1823 Ms=6.6; January 19, 1833 Ms=6.6; October 12, 1851 Ms=6.6; January 2, 1866 Ms=6.6; December 4, 1866 Ms=6.6; February 11, 1872 Ms=6.6; June 14, 1893 Ms=6.6; November 26, 1920 Ms=6.4 (Sulstarova et al., 2005).

Microtectonic studies and focal mechanism solutions of the earthquakes demonstrate that the Ionian thrust fault zone is now in compressional regime with a SW-NE trend (Aliaj, 1988; Sulstarova, 1986; Muço, 1994). The future earthquakes may occur in the Ionian coastal fault zone with Mmax=7.0.

4. Peja-Prizreni (PP) is an interior zone in Kosova comprising three normal fault systems N- ENE- and WNW-trending, along the boundaries of Dukagjini Pliocene-Quaternary Depression (Elezaj, 2002).

Strong earthquakes generally have been generated at tectonic knots near Prizreni and Peja towns, as follows: June 16, 1456 Ms=6.6; February 11, 1662 Ms=6.0 (Sulstarova et al., 2005a). The expected seismic potential here estimates $M_{max}=6.8$.

5. Kukesi-Peshkopi (KP) is an interior zone comprising Pliocene-Quaternary N-trending normal fault controlled grabens. Along this normal fault zone have been recorded the following strong earthquakes: December 7, 1922 Ms=5.7; March 30, 1921 Ms=5.8; August 27, 1942 Ms=6.0 (Sulstarova et al., 2005).

Stress pattern deduced from structural analysis of faults for Middle Pleistocene to present-day and from focal mechanism solutions of earthquakes shows that the Kukesi-Peshkopi normal fault zone has been subjected to a NW-SE extension (Aliaj, 1988, 1996; Muço, 1994).

Considering that the Kukesi-Peshkopi zone has the similar environment to Ohrid-Korça zone, the future earthquakes may also occur here with $M_{max}=6.5$.

6. Ohrid-Korça (KO) is an interior zone comprising Pliocene-Quaternary normal fault-controlled Ohrid graben, and Korça and Erseka half-grabens, which are generally N-trending.

Geodynamically, it is the most active area with the greatest seismic activity in the eastern Albania. Along it the following strong earthquakes have been recorded: 526 year Io=IX MSK-64; February 18, 1911 Ms=6.7; December 22, 1919 Ms=6.1; January 28, 1931 Ms=5.8; May 26, 1960 Ms=6.4 (Sulstarova et al., 1975, 2005a; Reicherter, 2008)).

Stress pattern deduced from structural analysis of faults for Middle Pleistocene to present-day and from focal mechanism solutions of earthquakes shows that the Ohrid-Korça normal fault zone has been subjected to NW-SE extension (Aliaj, 1988, 1996; Muço, 1994). The seismic potential of future earthquakes here estimates $M_{max}=6.9$.

7. Shkodra-Tropoja (ST) is a transverse interior zone comprising NE- striking normal faults, mainly along the boundary of Mirdita ophiolite zone. Along it the following earthquakes have been recorded: July 7, 1855 Ms=5.5; August 27, 1948 Ms=5.5.

The composite focal mechanism solutions of earthquakes generated from this fault zone show the tensional regime extending NWN (Muço, 1994).

Taking into consideration that the Shkodra-Tropoja zone has similar environment to Elbasani-Dibra-Tetova zone, the future earthquakes may also occur here with $M_{max}=6.5$.

8. Elbasani-Dibra-Tetova (EDT) is a transverse interior zone comprising fragmentary NE-striking normal faults, along which have been recorded the following strong earthquakes: 1380 Ms=6.6; September 5, 1843 Ms=6.3; August 16, 1907 Ms=6.2; March 31, 1935 Ms=5.7; March 12, 1960 Ms=5.8; November 30, 1967 Ms=6.6 etc. (Sulstarova et al., 2005).

The focal mechanism solution of November 30, 1967 evinces generation by horizontal tensional stresses, NW-SE trending (Sulstarova, 1986; Muço, 1994).

The future earthquakes along the Elbasani-Dibra normal fault zone with surmised $M_{max}=6.8$ can be awaited. It is important to underline that this transverse seismic source zone is the most seismoactive one in Albania.

9. Skopje (SK) is an interior zone in Macedonia-Kosova border region comprising NW and NE-striking normal faults, along which the following strong earthquakes have been recorded: 518 year Ms= 7.2 (or 6.8); August 10, 1921 Ms=6.1; July 26, 1963 Ms=6.1 etc. (Sulstarova et al., 2005; Elezaj, 2002). The expected seismic potential estimates $M_{max}=6.5$ according to the Talaganov et al., 2003 estimation.

The Eastern Albanian Background is a zone of background seismicity, comprising the interior part of Albania and neighbouring regions lying to the east of the coastal zones, that was not taken into consideration for hazard calculation, due to the low magnitudes than Ms 4.5, Minimum magnitude accepted for hazard calculation.

Ground motion prediction model: Selection of ground motion relationships (Sh.Aliaj, B.Muço, E.Sulstrova)

Albania is characterized by shallow crustal seismicity. The different present-day tectonic regime in eastern and western Albania requires the use of separate strong motion relations. The extensional region, into which the normal faulting earthquakes are generated, is located in eastern Albania. The compressional region, into which mainly thrust faulting and much rare strike-slip faulting earthquakes are generated, is located in western part of it.

The style of faulting parameter is used to distinguish between different source types. For crustal earthquakes, ground motions systematically differ when generated by strike-slip, thrust, or normal fault mechanisms (Bolt and Abrahamson, 2003). Even the same earthquake magnitude, distance to site, and site condition, the ground motions from thrust earthquakes tend to be larger than the ground motions from the strike-slip earthquakes (about 20-30 %), and the ground motions from normal faulting earthquakes tend to be smaller than the ground motions from strike-slip earthquakes (about 20 % smaller) (Somerville and Abrahamson, 1995; Spudich et al, 1996).

Based on the above-mentioned differences in ground motions for crustal earthquakes generated by normal or thrust faulting, for study of seismic hazard of Albania were proposed to use the following attenuation relations of ground motions:

For seismic source zones in extensional regime (normal faulting), located in eastern Albania, the attenuation relation of Spudich et al., 1999 was used for the evaluation of ground shaking, while for seismic source zones in compressional regime (thrust faulting), located in western Albania, the attenuation relation of Somerville et al., 2001.

Computation of seismic hazard (Sh. Aliaj, B.Muço, E.Sulstarova)

Estimating seismic ground shaking is an important step in anticipating earthquake effects on people and structures.

The calculation of ground motion from attenuation relations for all earthquake sources is the last step in seismic hazard probabilistic analysis. For seismic hazard computation using the EZ-FRISK 7.12 computer code, a production of Risk Engineering Inc. CO, U. S. A., the Albanian territory, included within coordinates 38.8° - 43.2° N and 18.3° - 21.7° E, is divided into 1530 cells (with a grid of 0.1° - 0.1°).

The main parameters of seismic hazard for Albania: Peak ground Accelerations (PGA) and Spectral Accelerations (SA) damping 5 % are calculated in PC with Windows XP for rock site condition, and in accordance with Eurocode 8 for two levels of probability: 10 % in 50 years (475 years return period) and 10 % in 10 years (95 years return period). The ground motion values are calculated for „firm rock“ sites that correspond to a shear-wave velocity of 760 m/s in the top 30 m.

For evaluation of ground shaking, the attenuation relations of Spudich et al., 1999 and Sadigh et al., 1997 are used.

Presentation of the hazard results (Sh. Aliaj, B.Muço, E.Sulstarova)

The results obtained from seismic hazard calculations are presented on maps of seismic hazard and in tabular format.

In the Table 1 (out of text) are given values of seismic hazard (PGA and SA for 0.2, 0.5, 1.0, 2.0 sec (g)) for 370 municipalities and communes of Albania for probabilities 10 % / 10 years (95 years return period) and 10 % / 50 years (475 years return period) in rock site conditions.

The seismic hazard maps of PGA and Sa (0.2, 0.5, 1.0 and 2.0 sec.) for two levels of probability are compiled (see Figures 1 - 12, out of text).

In the Table 2 (out of text) are given full spectral values (Sa g for 0.1, 0.2, 0.3, 0.4, 0.5, 0.75, 1.0 and 2.0 sec.) for 36 towns of Albania for probabilities 10 % / 10 years (95 years return period) and 10 % / 50 years (475 years return period) in rock site conditions, based on which are compiled the uniform hazard spectra for each town (see Figures 13 - 20, out of text).

Some results presented on the map of PGA seismic hazard on rock sites for a probability 10 % in 50 years (Figure 1, out of text) are given below.

The PGA values, rock site conditions, for probability of 10 % in 50 years or 475 years return period, are the largest ones along the Ionian-Adriatic coastal earthquake belt going from 0.24 g in Southern Albania to 0.25-0.30 g from Vlora to Lezha towns, and up to 0.40 g NW of Shkodra town, along the Dalmatian coast; while in Eastern Albania the PGA values are 0.20-0.22 g from Ohrid Lake to Leskoviku, and from Kukesi to Peshkopia districts; the highest values of PGA 0.20-0.30 g in Eastern Albania are along the Elbasani-Dibra and Shkodra-Tropoja transversals. The lowest values of PGA 0.12-0.15 g are in Moker, Mat-Mirdite and Has-Gjakove areas, and 0.07-0.15 g in northern extremity of the country from Vermoshi to Dukagjini areas.

As it is seen from this map the highest values of PGA are along the western coastal part of the country, along the Adriatic collision zone, where the Albanian orogen overthrusts on Adria Microplate, as well as along the Elbasani-Dibra and Shkodra-Tropoja transversals.

On the seismic hazard map for a probability 95 years return period (see Figure 2, out of text) the PGA values are about half of PGA values for a probability 475 years.

The values of spectral acceleration – Sa for five different periods are given in respective maps (see Figures 3 - 12, out of text)

The probabilistic seismic hazard evaluation for Albania should serve as the base for new building code of our country.

ANNEX I

The tables of seismic hazard for albania

Table 1. Seismic hazard values (PGA and SA (g)) for 370 municipalities and communes of Albania with probability 10%/10 years (95 years return period) and 10%/50 years (475 years return period) on rock site conditions.

County Municipality	Coordinates		Probab	PGA 0.01 s	SA				
	N	E			0.2 s	0.5 s	1.0 s	2.0 s	
1. BERAT 1. Berat	40.71	19.94	10%/10 10%/50	0.13 0.266	0.309 0.62	0.16 0.353	0.08 0.178	0.034 0.076	

2. Cukalat	40.73	19.79	10%/10 10%/50	0.137 0.272	0.323 0.637	0.168 0.367	0.084 0.187	0.035 0.08
3. Kutalli	40.79	19.79	10%/10 10%/50	0.138 0.272	0.328 0.639	0.172 0.369	0.086 0.189	0.036 0.081
4. Lumas	40.83	20.01	10%/10 10%/50	0.118 0.234	0.28 0.553	0.149 0.316	0.075 0.16	0.032 0.071
5. Otlak	40.74	19.94	10%/10 10%/50	0.13 0.266	0.309 0.62	0.16 0.353	0.08 0.178	0.034 0.076
6. Poshnjë	40.78	19.82	10%/10 10%/50	0.138 0.272	0.328 0.639	0.172 0.369	0.086 0.189	0.036 0.081
7. Roshnik	40.73	20.03	10%/10 10%/50	0.117 0.243	0.278 0.568	0.146 0.321	0.074 0.162	0.032 0.071
8. Sinjë	40.64	19.85	10%/10 10%/50	0.132 0.267	0.313 0.624	0.162 0.358	0.081 0.181	0.034 0.077
9. Terpan	40.55	20.01	10%/10 10%/50	0.114 0.243	0.269 0.565	0.14 0.316	0.71 0.159	0.03 0.069
10. Ura Vajgurore	40.76	19.84	10%/10 10%/50	0.137 0.272	0.323 0.637	0.168 0.367	0.084 0.187	0.035 0.08
11. Velabisht	40.70	19.91	10%/10 10%/50	0.13 0.266	0.309 0.62	0.16 0.353	0.08 0.178	0.034 0.076
12. Vërtop	40.63	20.05	10%/10 10%/50	0.117 0.247	0.276 0.575	0.144 0.322	0.073 0.162	0.031 0.07
2. BULQIZË								
1. Bulqizë	41.49	20.23	10%/10 10%/50	0.101 0.155	0.259 0.449	0.14 0.252	0.069 0.126	0.032 0.063
2. Fushë-Bulqizë	41.53	20.26	10%/10 10%/50	0.101 0.155	0.259 0.449	0.14 0.252	0.069 0.126	0.032 0.063
3. Gjoricë	41.53	20.43	10%/10 10%/50	0.139 0.244	0.342 0.642	0.184 0.367	0.086 0.181	0.039 0.085
4. Klenjë	41.36	20.44	10%/10 10%/50	0.148 0.268	0.357 0.692	0.195 0.404	0.092 0.202	0.041 0.092
5. Martanesh	41.37	20.18	10%/10 10%/50	0.123 0.214	0.309 0.573	0.168 0.328	0.081 0.183	0.037 0.077
6. Ostren	41.43	20.44	10%/10 10%/50	0.159 0.287	0.376 0.732	0.206 0.431	0.097 0.217	0.043 0.096
7. Shupenzë	41.53	20.40	10%/10 10%/50	0.139 0.244	0.342 0.642	0.184 0.367	0.086 0.181	0.039 0.085
8. Zerqan	41.50	20.35	10%/10 10%/50	0.117 0.197	0.299 0.537	0.158 0.301	0.076 0.146	0.035 0.072
3. DELVINË								
1. Delvinë	39.95	20.05	10%/10 10%/50	0.116 0.243	0.268 0.565	0.136 0.318	0.069 0.159	0.026 0.069
2. Finiq	39.90	20.05	10%/10 10%/50	0.165 0.243	0.27 0.565	0.136 0.319	0.07 0.16	0.029 0.069
3. Mesopotam	39.91	20.08	10%/10 10%/50	0.116 0.243	0.269 0.565	0.137 0.318	0.07 0.159	0.029 0.069
4. Vergo	40.00	20.01	10%/10 10%/50	0.116 0.243	0.269 0.565	0.137 0.318	0.07 0.159	0.029 0.069
4. DEVOLL								
1. Bilisht Bashki	40.63	20.98	10%/10 10%/50	0.107 0.203	0.242 0.489	0.127 0.271	0.058 0.129	0.026 0.059
2. Bilisht	40.64	20.97	10%/10 10%/50	0.107 0.203	0.242 0.489	0.127 0.271	0.058 0.129	0.026 0.059
3. Hoçisht	40.60	20.89	10%/10 10%/50	0.118 0.217	0.269 0.534	0.141 0.299	0.065 0.142	0.029 0.066

4. Miras	40.51	20.92	10%/10 10%/50	0.111 0.209	0.25 0.507	0.132 0.282	0.061 0.134	0.027 0.062
5. Progër	40.69	20.93	10%/10 10%/50	0.121 0.219	0.279 0.545	0.146 0.306	0.068 0.146	0.03 0.068
5. DIBËR								
1. Arras	41.73	20.32	10%/10 10%/50	0.12 0.209	0.26 0.494	0.15 0.275	0.072 0.133	0.033 0.064
2. Fushe-Çidhën	41.76	20.34	10%/10 10%/50	0.12 0.209	0.26 0.494	0.15 0.275	0.072 0.133	0.033 0.064
3. Kala e Dodës	41.82	20.45	10%/10 10%/50	0.131 0.219	0.312 0.544	0.164 0.303	0.077 0.144	0.034 0.069
4. Kastriot	41.73	20.38	10%/10 10%/50	0.129 0.218	0.306 0.537	0.162 0.3	0.077 0.143	0.035 0.069
5. Lura e Vjeter	41.81	20.20	10%/10 10%/50	0.105 0.18	0.246 0.428	0.134 0.239	0.066 0.118	0.03 0.057
6. Luzni	41.63	20.36	10%/10 10%/50	0.13 0.22	0.319 0.565	0.169 0.317	0.08 0.153	0.036 0.074
7. Maqellarë	41.58	20.48	10%/10 10%/50	0.147 0.25	0.355 0.65	0.191 0.37	0.089 0.182	0.04 0.085
8. Melan	41.65	20.46	10%/10 10%/50	0.147 0.25	0.355 0.65	0.191 0.37	0.089 0.182	0.04 0.085
9. Muhurr	41.67	20.31	10%/10 10%/50	0.12 0.209	0.26 0.494	0.15 0.275	0.072 0.133	0.033 0.064
10. Peshkopi	41.69	20.43	10%/10 10%/50	0.129 0.218	0.306 0.537	0.162 0.3	0.077 0.143	0.035 0.069
11. Qendër Tomin	41.69	20.41	10%/10 10%/50	0.129 0.218	0.306 0.537	0.162 0.3	0.077 0.143	0.035 0.069
12. Selishtë	41.61	20.26	10%/10 10%/50	0.116 0.2	0.283 0.498	0.151 0.278	0.073 0.135	0.033 0.066
13. Sllovë	41.79	20.40	10%/10 10%/50	0.127 0.215	0.297 0.519	0.156 0.286	0.074 0.137	0.033 0.066
14. Zall Dardhë	41.81	20.33	10%/10 10%/50	0.121 0.21	0.276 0.49	0.147 0.271	0.071 0.131	0.032 0.062
15. Zall Reç	41.86	20.31	10%/10 10%/50	0.121 0.21	0.276 0.49	0.147 0.271	0.071 0.131	0.032 0.062
6. DURRËS								
1. Durrës	41.31	19.41	10%/10 10%/50	0.133 0.268	0.313 0.626	0.163 0.359	0.083 0.183	0.036 0.078
2. Gjepalaj	41.33	19.58	10%/10 10%/50	0.138 0.273	0.33 0.64	0.174 0.371	0.087 0.19	0.037 0.081
3. Ishëm	41.56	19.51	10%/10 10%/50	0.141 0.275	0.333 0.644	0.179 0.378	0.091 0.196	0.036 0.084
4. Katund i Ri	41.40	19.49	10%/10 10%/50	0.137 0.273	0.325 0.639	0.171 0.369	0.087 0.189	0.037 0.081
5. Maminas	41.37	19.59	10%/10 10%/50	0.138 0.273	0.33 0.64	0.174 0.371	0.087 0.19	0.037 0.081
6. Manëz	41.43	19.59	10%/10 10%/50	0.136 0.271	0.323 0.635	0.171 0.366	0.086 0.187	0.037 0.08
7. Rrashbull	41.33	19.49	10%/10 10%/50	0.138 0.273	0.328 0.64	0.172 0.371	0.087 0.19	0.036 0.081
8. Shijak	41.34	19.57	10%/10 10%/50	0.138 0.273	0.33 0.64	0.174 0.371	0.087 0.19	0.037 0.081
9. Sukth	41.37	19.54	10%/10 10%/50	0.137 0.273	0.325 0.639	0.171 0.369	0.087 0.189	0.037 0.081
10. Xhafzotaj	41.34	19.52	10%/10	0.138	0.328	0.172	0.087	0.036

			10%/50	0.273	0.64	0.371	0.19	0.08
7. ELBASAN								
1. Belsh	40.97	19.87	10%/10 10%/50	0.14 0.265	0.339 0.65	0.181 0.373	0.09 0.19	0.038 0.083
2. Bradashesh	41.10	20.00	10%/10 10%/50	0.162 0.296	0.375 0.737	0.21 0.435	0.102 0.222	0.044 0.098
3. Cerrik	41.03	19.97	10%/10 10%/50	0.14 0.265	0.339 0.65	0.181 0.373	0.09 0.19	0.038 0.083
4. Elbasan	41.12	20.05	10%/10 10%/50	0.162 0.296	0.375 0.727	0.21 0.435	0.102 0.222	0.044 0.098
5. Fierz	40.92	19.85	10%/10 10%/50	0.139 0.271	0.333 0.641	0.176 0.37	0.088 0.189	0.037 0.081
6. Funar	41.17	20.06	10%/10 10%/50	0.185 0.293	0.385 0.742	0.216 0.445	0.106 0.226	0.046 0.102
7. Gjegjan	40.93	20.02	10%/10 10%/50	0.12 0.23	0.294 0.56	0.157 0.323	0.079 0.164	0.034 0.074
8. Gjinar	41.01	20.19	10%/10 10%/50	0.105 0.172	0.264 0.472	0.144 0.275	0.072 0.138	0.033 0.067
9. Gostimë	40.99	19.99	10%/10 10%/50	0.14 0.265	0.339 0.65	0.181 0.373	0.09 0.19	0.038 0.083
10. Gracen	41.14	19.96	10%/10 10%/50	0.147 0.272	0.355 0.678	0.192 0.391	0.094 0.199	0.041 0.088
11. Grekan	40.93	19.94	10%/10 10%/50	0.132 0.26	0.32 0.62	0.169 0.355	0.084 0.18	0.036 0.079
12. Kajan	40.91	19.88	10%/10 10%/50	0.139 0.271	0.333 0.641	0.176 0.37	0.088 0.189	0.037 0.081
13. Klos	40.94	20.01	10%/10 10%/50	0.12 0.23	0.294 0.56	0.157 0.323	0.079 0.164	0.034 0.074
14. Labinot-Fushë	41.15	20.13	10%/10 10%/50	0.157 0.285	0.366 0.714	0.207 0.427	0.101 0.218	0.044 0.097
15. Labinot- Mal	41.18	20.14	10%/10 10%/50	0.165 0.293	0.385 0.742	0.216 0.445	0.105 0.226	0.046 0.102
16. Mollas	40.92	20.01	10%/10 10%/50	0.12 0.23	0.294 0.56	0.157 0.323	0.079 0.164	0.034 0.074
17. Papër	41.05	19.95	10%/10 10%/50	0.14 0.285	0.339 0.65	0.181 0.373	0.09 0.19	0.049 0.083
18. Rrasë	40.97	19.81	10%/10 10%/50	0.139 0.271	0.333 0.641	0.176 0.37	0.088 0.189	0.037 0.081
19. Shalës	41.00	19.93	10%/10 10%/50	0.14 0.285	0.339 0.65	0.181 0.373	0.09 0.19	0.049 0.083
20. Shirgjan	41.04	20.05	10%/10 10%/50	0.14 0.265	0.339 0.65	0.181 0.373	0.09 0.19	0.038 0.083
21. Shushicë	41.10	20.13	10%/10 10%/50	0.157 0.285	0.366 0.714	0.207 0.427	0.101 0.218	0.044 0.097
22. Tregan	41.03	20.07	10%/10 10%/50	0.157 0.285	0.339 0.65	0.181 0.373	0.09 0.19	0.038 0.083
23. Zavalinë	40.98	20.27	10%/10 10%/50	0.092 0.14	0.24 0.412	0.131 0.237	0.065 0.12	0.03 0.059
8. FIER								
1. Cakran	40.60	19.61	10%/10 10%/50	0.133 0.266	0.313 0.621	0.163 0.36	0.082 0.183	0.034 0.078
2. Dermenas	40.74	19.48	10%/10 10%/50	0.136 0.271	0.32 0.634	0.165 0.366	0.083 0.186	0.034 0.079
3. Fier	40.73	19.53	10%/10	0.136	0.32	0.165	0.083	0.034

			10%/50	0.271	0.634	0.366	0.186	0.079
4. Frakull	40.65	19.50	10%/10	0.13	0.305	0.156	0.079	0.032
			10%/50	0.263	0.615	0.352	0.178	0.076
5. Kuman	40.72	19.69	10%/10	0.139	0.328	0.171	0.086	0.035
			10%/50	0.273	0.64	0.372	0.19	0.081
6. Kurjan	40.71	19.73	10%/10	0.139	0.328	0.171	0.086	0.035
			10%/50	0.273	0.64	0.372	0.19	0.081
7. Levan	40.67	19.49	10%/10	0.136	0.32	0.165	0.083	0.034
			10%/50	0.271	0.634	0.366	0.186	0.079
8. Libofsh	40.83	19.45	10%/10	0.131	0.309	0.159	0.08	0.033
			10%/50	0.266	0.622	0.356	0.18	0.077
9. Mbrostar	40.75	19.58	10%/10	0.138	0.327	0.17	0.085	0.035
			10%/50	0.273	0.639	0.371	0.19	0.08
10. Patos	40.67	19.61	10%/10	0.138	0.327	0.17	0.085	0.035
			10%/50	0.273	0.639	0.371	0.19	0.08
11. Portëz	40.70	19.57	10%/10	0.138	0.327	0.17	0.085	0.035
			105/50	0.273	0.639	0.371	0.19	0.08
12. Qendër	40.74	19.51	10%/10	0.136	0.32	0.165	0.083	0.034
			10%/50	0.271	0.634	0.366	0.186	0.079
13. Roskovec	40.74	19.69	10%/10	0.139	0.328	0.171	0.086	0.035
			10%/50	0.273	0.64	0.372	0.19	0.081
14. Rruzhdie	40.67	19.69	10%/10	0.134	0.315	0.163	0.082	0.034
			10%/50	0.267	0.624	0.36	0.183	0.078
15. Strum	40.74	19.73	10%/10	0.139	0.328	0.171	0.086	0.035
			10%/50	0.273	0.64	0.372	0.19	0.081
16. Topojë	40.75	19.42	10%/10	0.129	0.303	0.155	0.088	0.032
			10%/50	0.265	0.618	0.351	0.177	0.076
17. Zharrëz	40.70	19.66	10%/10	0.138	0.327	0.17	0.085	0.035
			10%/50	0.273	0.639	0.371	0.19	0.08
9. GRAMSH								
1. Gramsh	40.86	20.19	10%/10	0.084	0.217	0.12	0.061	0.028
			10%/50	0.141	0.373	0.225	0.118	0.056
2. Kodovjat	40.81	20.25	10%/10	0.084	0.217	0.12	0.061	0.028
			10%/50	0.141	0.373	0.225	0.118	0.056
3. Kukur	40.86	20.36	10%/10	0.083	0.212	0.117	0.058	0.027
			10%/50	0.131	0.364	0.211	0.107	0.053
4. Kushovë	40.78	20.19	10%/10	0.084	0.217	0.12	0.061	0.028
			10%/50	0.141	0.373	0.225	0.118	0.056
5. Lenie	40.77	20.39	10%/10	0.083	0.212	0.117	0.058	0.027
			10%/50	0.131	0.364	0.211	0.107	0.053
6. Pishaj	40.87	20.18	10%/10	0.084	0.217	0.12	0.061	0.028
			10%/50	0.141	0.373	0.225	0.118	0.056
7. Poroçan	40.94	20.28	10%/10	0.082	0.217	0.12	0.06	0.026
			10%/50	0.125	0.361	0.214	0.11	0.054
8. Skenderbegas	40.77	20.21	10%/10	0.083	0.213	0.118	0.06	0.027
			10%/50	0.148	0.376	0.225	0.119	0.055
9. Sult	40.88	20.10	10%/10	0.104	0.258	0.141	0.072	0.032
			10%/50	0.184	0.469	0.276	0.141	0.066
10. Tunjë	40.83	20.09	10%/10	0.098	0.243	0.132	0.068	0.03
			10%/50	0.184	0.451	0.265	0.137	0.063
10. GJIROKASTËR								
1. Antigone	40.07	20.20	10%/10	0.111	0.258	0.132	0.066	0.028
			10%/50	0.238	0.555	0.306	0.152	0.066
2. Cepo	40.13	20.08	10%/10	0.114	0.265	0.135	0.068	0.029
			10%/50	0.242	0.562	0.314	0.156	0.068

3. Gjirokastrë	40.07	20.08	10%/10 10%/50	0.115 0.242	0.269 0.565	0.137 0.318	0.07 0.159	0.029 0.069
4. Lazarat	40.04	20.13	10%/10 10%/50	0.115 0.242	0.268 0.564	0.137 0.317	0.069 0.158	0.029 0.068
5. Libohovë	40.02	20.27	10%/10 10%/50	0.113 0.241	0.263 0.561	0.134 0.312	0.068 0.155	0.028 0.067
6. Lunxhëri	40.16	20.13	10%/10 10%/50	0.111 0.239	0.26 0.557	0.133 0.308	0.067 0.153	0.028 0.066
7. Odrie	40.18	20.10	10%/10 10%/50	0.111 0.239	0.26 0.557	0.133 0.308	0.067 0.153	0.028 0.066
8. Picar	40.17	20.04	10%/10 10%/50	0.115 0.242	0.266 0.564	0.137 0.317	0.07 0.158	0.029 0.068
9. Qëndër Libohovë	40.02	20.27	10%/10 10%/50	0.113 0.241	0.263 0.561	0.134 0.312	0.068 0.155	0.028 0.067
10. Zagorie	40.22	20.24	10%/10 10%/50	0.105 0.231	0.248 0.538	0.128 0.294	0.064 0.148	0.028 0.064
11. HAS								
1. Fajzë	42.17	20.35	10%/10 10%/50	0.105 0.182	0.243 0.432	0.128 0.236	0.061 0.113	0.028 0.054
2. Golaj	42.24	20.36	10%/10 10%/50	0.086 0.132	0.219 0.379	0.114 0.203	0.054 0.098	0.025 0.049
3. Gjinaj	42.12	20.43	10%/10 10%/50	0.105 0.183	0.241 0.431	0.127 0.234	0.06 0.112	0.027 0.054
4. Krumë	42.18	20.42	10%/10 10%/50	0.082 0.126	0.209 0.356	0.109 0.19	0.051 0.091	0.024 0.45
12. KAVAJË								
1. Golem	41.24	19.53	10%/10 10%/50	0.139 0.273	0.33 0.641	0.173 0.372	0.087 0.191	0.037 0.081
2. Gosë	41.09	19.62	10%/10 10%/50	0.141 0.274	0.338 0.645	0.179 0.377	0.09 0.194	0.038 0.083
3. Helmës	41.18	19.59	10%/10 10%/500	0.14 0.274	0.355 0.644	0.177 0.375	0.089 0.192	0.037 0.082
4. Kavajë	41.18	19.56	10%/10 10%/50	0.139 0.273	0.33 0.641	0.173 0.372	0.087 0.191	0.037 0.081
5. Kryevidh	41.09	19.53	10%/10 10%/50	0.139 0.273	0.33 0.641	0.174 0.373	0.087 0.191	0.036 0.081
6. Lekaj	41.11	19.61	10%/10 10%/50	0.141 0.274	0.338 0.645	0.179 0.377	0.09 0.194	0.038 0.083
7. Luz i Vogël	41.15	19.53	10%/10 10%/50	0.139 0.273	0.33 0.641	0.174 0.373	0.087 0.191	0.036 0.081
8. Rrogozhinë	41.08	19.64	10%/10 10%/50	0.141 0.274	0.338 0.645	0.179 0.377	0.09 0.194	0.038 0.083
9. Sinbellaj	41.07	19.68	10%/10 10%/50	0.142 0.274	0.34 0.647	0.181 0.377	0.09 0.194	0.038 0.083
10. Synej	41.17	19.53	10%/10 10%/50	0.139 0.273	0.33 0.641	0.174 0.373	0.087 0.191	0.036 0.081
13. KOLONJË								
1. Barmash	40.27	20.59	10%/10 10%/50	0.113 0.213	0.249 0.508	0.135 0.29	0.066 0.141	0.029 0.064
2. Çlirim	40.42	20.54	10%/10 10%/50	0.101 0.181	0.231 0.446	0.126 0.255	0.062 0.126	0.028 0.059
3. Ersekë	40.34	20.66	10%/10 10%/50	0.115 0.215	0.25 0.516	0.135 0.291	0.065 0.141	0.029 0.064
4. Leskovik Bashki	40.16	20.59	10%/10 10%/50	0.11 0.21	0.237 0.49	0.13 0.282	0.064 0.139	0.028 0.063

5. Leskovik	40.20	20.59	10%/10 10%/50	0.11 0.21	0.237 0.49	0.13 0.282	0.064 0.139	0.028 0.063
6. Mollas	40.42	20.68	10%/10 10%/50	0.118 0.218	0.264 0.533	0.141 0.3	0.067 0.144	0.029 0.066
7. Novoselë	40.32	20.57	10%/10 10%/50	0.113 0.213	0.249 0.508	0.135 0.29	0.066 0.141	0.029 0.064
8. Qendër Ersekë	40.34	20.66	10%/10 10%/50	0.115 0.215	0.25 0.516	0.135 0.291	0.065 0.141	0.029 0.064
14. KORÇË								
1. Drenovë	40.58	20.76	10%/10 10%/50	0.122 0.22	0.28 0.547	0.147 0.308	0.069 0.147	0.03 0.068
2. Gorë	40.75	20.57	10%/10 10%/50	0.115 0.213	0.265 0.519	0.142 0.292	0.068 0.141	0.03 0.066
3. Korçë	40.61	20.79	10%/10 10%/50	0.122 0.22	0.28 0.547	0.147 0.308	0.069 0.147	0.03 0.068
4. Lekas	40.60	20.51	10%/10 10%/50	0.099 0.177	0.232 0.442	0.126 0.249	0.062 0.123	0.028 0.058
5. Libonik	40.70	20.72	10%/10 10%/50	0.121 0.219	0.282 0.546	0.149 0.307	0.07 0.147	0.031 0.069
6. Liqenas	40.78	20.88	10%/10 10%/50	0.123 0.22	0.209 0.553	0.151 0.311	0.07 0.149	0.031 0.07
7. Maliq	40.69	20.68	10%/10 10%/50	0.121 0.219	0.282 0.546	0.149 0.307	0.07 0.147	0.031 0.069
8. Moglicë	40.70	20.42	10%/10 10%/50	0.082 0.132	0.209 0.361	0.115 0.21	0.057 0.107	0.026 0.052
9. Mollaj	40.50	20.68	10%/10 10%/50	0.12 0.219	0.273 0.541	0.145 0.304	0.068 0.146	0.03 0.068
10. Pirg	40.78	20.69	10%/10 10%/50	0.122 0.219	0.264 0.547	0.15 0.308	0.07 0.148	0.031 0.069
11. Pojan	40.73	20.83	10%/10 10%/50	0.123 0.22	0.259 0.539	0.189 0.379	0.098 0.208	0.07 0.148
12. Qendër	40.65	20.75	10%/10 10%/50	0.123 0.22	0.259 0.539	0.189 0.379	0.098 0.208	0.07 0.148
13. Vithkuq	40.52	20.56	10%/10 10%/50	0.115 0.213	0.26 0.517	0.14 0.292	0.067 0.141	0.03 0.065
14. Voskop	40.60	20.69	10%/10 10%/50	0.121 0.219	0.279 0.554	0.147 0.306	0.069 0.147	0.031 0.068
15. Voskopojë	40.63	20.59	10%/10 10%/50	0.115 0.213	0.262 0.513	0.141 0.292	0.067 0.141	0.03 0.065
16. Vreshtas	40.80	20.77	10%/10 10%/50	0.123 0.22	0.262 0.54	0.191 0.38	0.098 0.207	0.07 0.149
15. KRUIË								
1. Bubq	41.47	19.66	10%/10 10%/50	0.134 0.266	0.317 0.626	0.169 0.362	0.086 0.185	0.037 0.08
2. Cudhi	41.51	19.87	10%/10 10%/50	0.107 0.209	0.262 0.495	0.145 0.293	0.075 0.151	0.033 0.069
3. Fushë-Krujë	41.48	19.72	10%/10 10%/50	0.123 0.249	0.295 0.583	0.159 0.336	0.081 0.172	0.035 0.075
4. Kodër Thumane	41.54	19.64	10%/10 10%/50	0.134 0.266	0.317 0.626	0.169 0.362	0.086 0.185	0.037 0.08
5. Krujë	41.51	19.76	10%/10 10%/50	0.123 0.249	0.295 0.583	0.159 0.336	0.081 0.172	0.035 0.075
6. Nikël	41.44	19.75	10%/10 10%/50	0.129 0.26	0.309 0.609	0.164 0.349	0.083 0.178	0.036 0.077
16. KUÇOVË								

1. Kozare	40.82	19.87	10%/10 10%/50	0.138 0.272	0.328 0.639	0.172 0.369	0.086 0.189	0.036 0.081
2. Kuçovë	40.79	19.92	10%/10 10%/50	0.13 0.263	0.312 0.617	0.163 0.352	0.082 0.178	0.044 0.077
3. Perondi	40.78	19.92	10%/10 10%/50	0.13 0.263	0.312 0.617	0.163 0.352	0.082 0.176	0.035 0.077
17. KUKËS								
1. Arrën	41.91	20.30	10%/10 10%/50	0.121 0.211	0.273 0.488	0.145 0.269	0.07 0.129	0.031 0.061
2. Bicaj	41.99	20.42	10%/10 10%/50	0.121 0.212	0.272 0.491	0.143 0.268	0.068 0.128	0.03 0.06
3. Bushtricë	41.89	20.39	10%/10 10%/50	0.125 0.214	0.286 0.507	0.15 0.278	0.071 0.132	0.032 0.063
4. Grykë Çaj	41.87	20.52	10%/10 10%/50	0.126 0.215	0.294 0.517	0.154 0.285	0.072 0.135	0.032 0.065
5. Kalis	41.84	20.35	10%/10 10%/50	0.121 0.21	0.276 0.49	0.147 0.271	0.071 0.131	0.032 0.062
6. Kolsh	42.08	20.33	10%/10 10%/50	0.105 0.182	0.243 0.432	0.13 0.238	0.063 0.116	0.029 0.056
7. Kukës	42.05	20.40	10%/10 10%/50	0.121 0.212	0.272 0.491	0.143 0.268	0.068 0.128	0.03 0.06
8. Malziu	42.08	20.30	10%/10 10%/50	0.105 0.182	0.243 0.432	0.13 0.238	0.063 0.116	0.029 0.056
9. Shistavec	41.97	20.58	10%/10 10%/50	0.116 0.205	0.268 0.483	0.14 0.266	0.066 0.126	0.03 0.06
10. Shtiçen	42.03	20.43	10%/10 10%/50	0.121 0.212	0.272 0.491	0.143 0.268	0.068 0.128	0.03 0.06
11. Surroj	41.98	20.34	10%/10 10%/50	0.119 0.21	0.266 0.481	0.142 0.264	0.068 0.127	0.03 0.06
12. Terthore	42.07	20.48	10%/10 10%/50	0.104 0.183	0.238 0.429	0.125 0.234	0.058 0.111	0.027 0.053
13. Topojan	41.98	20.52	10%/10 10%/50	0.121 0.212	0.274 0.493	0.144 0.27	0.068 0.128	0.03 0.061
14. Ujmisht	41.93	20.37	10%/10 10%/50	0.125 0.214	0.286 0.507	0.15 0.278	0.071 0.132	0.032 0.063
15. Zapod Orgjost	42.05	20.53	10%/10 10%/50	0.121 0.212	0.274 0.493	0.144 0.27	0.068 0.128	0.03 0.061
18. KURBIN								
1. Fushë Kuqe	41.65	19.60	10%/10 10%/50	0.135 0.267	0.321 0.625	0.172 0.365	0.088 0.189	0.037 0.081
2. Laç	41.62	19.71	10%/10 10%/50	0.12 0.237	0.269 0.558	0.157 0.329	0.081 0.17	0.035 0.075
3. Mamurras	41.58	19.69	10%/10 10%/50	0.12 0.237	0.269 0.556	0.157 0.329	0.081 0.17	0.035 0.075
4. Milot	41.68	19.72	10%/10 10%/50	0.125 0.238	0.303 0.564	0.164 0.339	0.084 0.176	0.036 0.077
19. LEZHË								
1. Balldren i Ri	41.83	19.61	10%/10 10%/50	0.176 0.338	0.412 0.788	0.211 0.45	0.103 0.227	0.043 0.097
2. Blinisht	41.87	19.62	10%/10 10%/50	0.199 0.373	0.46 0.873	0.231 0.493	0.111 0.245	0.047 0.104
3. Dajç	41.91	19.59	10%/10 10%/50	0.199 0.373	0.46 0.873	0.231 0.493	0.111 0.245	0.047 0.104
4. Kallmet i Madh	41.84	19.66	10%/10 10%/50	0.143 0.274	0.344 0.651	0.181 0.379	0.091 0.195	0.039 0.084

5. Kolç	41.78	19.68	10%/10 10%/50	0.143 0.274	0.344 0.651	0.181 0.379	0.091 0.195	0.039 0.084
6. Lezhë	41.78	19.62	10%/10 10%/50	0.176 0.338	0.412 0.788	0.211 0.45	0.103 0.227	0.043 0.097
7. Shëngjin	41.81	19.56	10%/10 10%/50	0.176 0.338	0.412 0.788	0.211 0.45	0.103 0.227	0.043 0.097
8. Shënkoll	41.69	19.64	10%/10 10%/50	0.147 0.285	0.349 0.669	0.186 0.393	0.093 0.203	0.039 0.086
9. Ungrej	41.86	19.79	10%/10 10%/50	0.114 0.208	0.26 0.507	0.152 0.304	0.078 0.157	0.034 0.072
10. Zejmen	41.71	19.69	10%/10 10%/50	0.125 0.238	0.303 0.564	0.184 0.339	0.084 0.176	0.036 0.077
20. LIBRAZHD								
1. Hotolisht	41.14	20.38	10%/10 10%/50	0.101 0.157	0.261 0.458	0.139 0.256	0.068 0.126	0.031 0.063
2. Librazhd	41.18	20.32	10%/10 10%/50	0.141 0.254	0.344 0.66	0.189 0.384	0.09 0.193	0.04 0.088
3. Lunik	41.28	20.32	10%/10 10%/50	0.16 0.29	0.379 0.739	0.21 0.636	0.1 0.22	0.044 0.1
4. Orenjë	41.28	20.20	10%/10 10%/50	0.156 0.281	0.369 0.718	0.206 0.624	0.099 0.214	0.043 0.097
5. Prrenjas	41.07	20.54	10%/10 10%/50	0.102 0.178	0.261 0.458	0.135 0.257	0.065 0.126	0.03 0.061
6. Polis	41.13	20.25	10%/10 10%/50	0.133 0.237	0.325 0.617	0.179 0.361	0.087 0.181	0.039 0.084
7. Qëndër Librazhd	41.20	20.32	10%/10 10%/50	0.141 0.254	0.344 0.66	0.189 0.384	0.09 0.193	0.04 0.088
8. Qukës	41.08	20.46	10%/10 10%/50	0.101 0.157	0.261 0.458	0.139 0.256	0.068 0.126	0.031 0.063
9. Rrajcë	41.09	20.55	10%/10 10%/50	0.105 0.181	0.263 0.475	0.14 0.266	0.068 0.13	0.031 0.063
10. Steblevë	41.34	20.45	10%/10 10%/50	0.148 0.268	0.357 0.692	0.195 0.404	0.092 0.202	0.041 0.092
11. Stravaj	40.99	20.41	10%/10 10%/50	0.09 0.14	0.235 0.408	0.127 0.229	0.063 0.114	0.029 0.057
21. LUSHNJË								
1. Allkaj	40.85	19.76	10%/10 10%/50	0.141 0.274	0.334 0.643	0.176 0.376	0.088 0.193	0.036 0.082
2. Ballgat	40.99	19.76	10%/10 10%/50	0.142 0.274	0.34 0.647	0.181 0.377	0.09 0.194	0.038 0.083
3. Bubullimë	40.80	19.63	10%/10 10%/50	0.141 0.274	0.333 0.643	0.176 0.376	0.088 0.193	0.036 0.082
4. Divjakë	40.99	19.50	10%/10 10%/50	0.139 0.273	0.33 0.641	0.174 0.373	0.087 0.191	0.036 0.081
5. Dushk	40.99	19.65	10%/10 10%/50	0.142 0.274	0.338 0.645	0.179 0.378	0.09 0.194	0.037 0.083
6. Fier Shegan	40.87	19.78	10%/10 10%/50	0.138 0.272	0.328 0.639	0.172 0.369	0.086 0.189	0.036 0.081
7. Golem	40.56	19.64	10%/10 10%/50	0.141 0.274	0.336 0.644	0.178 0.377	0.089 0.194	0.083 0.037
8. Grabian	40.94	19.57	10%/10 10%/50	0.139 0.273	0.329 0.64	0.173 0.373	0.087 0.191	0.036 0.081
9. Gradishtë	40.89	19.57	10%/10 10%/50	0.139 0.273	0.329 0.64	0.173 0.373	0.087 0.191	0.036 0.081
10. Hysgjokaj	40.97	19.76	10%/10	0.14	0.34	0.18	0.09	0.038

			10%/50	0.271	0.648	0.373	0.191	0.083
11. Karbunarë	40.93	19.74	10%/10	0.141	0.337	0.179	0.089	0.037
			10%/50	0.274	0.645	0.377	0.194	0.083
12. Kolonjë	40.82	19.60	10%/10	0.141	0.333	0.176	0.088	0.036
			10%/50	0.274	0.643	0.376	0.193	0.082
13. Krutje	40.87	19.67	10%/10	0.141	0.337	0.179	0.089	0.037
			10%/50	0.274	0.645	0.377	0.194	0.083
14. Lushnjë	40.93	19.66	10%/10	0.141	0.336	0.178	0.089	0.037
			10%/50	0.274	0.645	0.377	0.194	0.083
15. Remas	40.89	19.49	10%/10	0.139	0.329	0.173	0.087	0.036
			10%/50	0.273	0.64	0.373	0.191	0.081
16. Tërbuf	41.02	19.62	10%/10	0.142	0.338	0.179	0.09	0.037
			10%/50	0.274	0.645	0.378	0.194	0.083
22. MALËSI E MADHE								
1. Gruemirë	42.15	19.52	10%/10	0.167	0.401	0.214	0.106	0.045
			10%/50	0.309	0.734	0.432	0.222	0.097
2. Kastrot	42.35	19.48	10%/10	0.098	0.239	0.138	0.074	0.032
			10%/50	0.159	0.407	0.262	0.141	0.067
3. Kelmend	42.51	19.60	10%/10	0.06	0.15	0.094	0.05	0.023
			10%/50	0.091	0.246	0.159	0.092	0.044
4. Koplik	42.21	19.44	10%/10	0.148	0.356	0.196	0.1	0.042
			10%/50	0.275	0.651	0.394	0.207	0.09
5. Qendër	42.23	19.46	10%/10	0.125	0.309	0.171	0.088	0.038
			10%/50	0.222	0.541	0.335	0.178	0.08
6. Shkrel	42.24	19.57	10%/10	0.114	0.285	0.159	0.082	0.036
			10%/50	0.192	0.492	0.304	0.158	0.074
23. MALLAKASTËR								
1. Aranitas	40.59	19.81	10%/10	0.132	0.313	0.162	0.081	0.034
			10%/50	0.267	0.624	0.358	0.181	0.077
2. Ballsh	40.59	19.72	10%/10	0.134	0.315	0.163	0.082	0.034
			10%/50	0.267	0.624	0.36	0.183	0.078
3. Fratar	40.48	19.81	10%/10	0.125	0.295	0.152	0.077	0.032
			10%/50	0.254	0.593	0.34	0.172	0.074
4. Greshicë	40.56	19.78	10%/10	0.125	0.295	0.152	0.077	0.032
			10%/50	0.254	0.593	0.34	0.172	0.074
5. Hekal	40.54	19.73	10%/10	0.128	0.296	0.153	0.076	0.032
			10%/50	0.253	0.592	0.34	0.173	0.074
6. Kutë	40.47	19.76	10%/10	0.119	0.276	0.143	0.073	0.03
			10%/50	0.244	0.57	0.324	0.163	0.071
7. Ngraçan	40.65	19.76	10%/10	0.132	0.313	0.162	0.081	0.034
			10%/50	0.267	0.624	0.358	0.181	0.077
8. Qendër	40.59	19.68	10%/10	0.134	0.315	0.163	0.082	0.034
			10%/50	0.267	0.624	0.36	0.183	0.078
9. Selitë	40.55	19.84	10%/10	0.125	0.295	0.152	0.077	0.032
			10%/50	0.254	0.593	0.34	0.172	0.074
24. MAT								
1. Baz	41.62	19.92	10%/10	0.087	0.224	0.127	0.067	0.03
			10%/50	0.146	0.375	0.234	0.125	0.059
2. Burrel	41.60	19.97	10%/10	0.081	0.214	0.121	0.063	0.029
			10%/50	0.124	0.342	0.212	0.113	0.055
3. Derjan	41.69	20.05	10%/10	0.081	0.212	0.12	0.062	0.029
			10%/50	0.121	0.355	0.208	0.111	0.054
4. Gurrë	41.52	20.01	10%/10	0.087	0.227	0.128	0.066	0.03
			10%/50	0.136	0.377	0.228	0.12	0.058
5. Klos	41.50	20.09	10%/10	0.089	0.235	0.13	0.066	0.03

			10%/50	0.134	0.393	0.229	0.118	0.058
6. Komsî	41.57	19.96	10%/10	0.093	0.236	0.133	0.069	0.031
			10%/50	0.162	0.412	0.25	0.132	0.062
7. Lis	41.62	20.09	10%/10	0.084	0.22	0.122	0.062	0.029
			10%/50	0.125	0.355	0.21	0.109	0.054
8. Macukull	41.69	20.12	10%/10	0.085	0.218	0.121	0.061	0.026
			10%/50	0.127	0.35	0.206	0.107	0.053
9. Rukaj	41.68	20.00	10%/10	0.081	0.212	0.12	0.062	0.029
			10%/50	0.121	0.355	0.208	0.111	0.054
10. Suç	41.57	20.05	10%/10	0.093	0.236	0.133	0.069	0.031
			10%/50	0.162	0.412	0.25	0.132	0.062
11. Ulëz	41.68	19.87	10%/10	0.104	0.254	0.142	0.074	0.033
			10%/50	0.186	0.451	0.279	0.147	0.068
12. Xibër	41.44	20.03	10%/10	0.101	0.257	0.142	0.073	0.033
			10%/50	0.182	0.445	0.263	0.135	0.065
25. MIRDITË								
1. Fane	41.92	20.15	10%/10	0.093	0.23	0.125	0.063	0.029
			10%/50	0.144	0.383	0.217	0.11	0.054
2. Kaçinar	41.89	19.89	10%/10	0.105	0.262	0.144	0.073	0.033
			10%/50	0.179	0.484	0.274	0.14	0.067
3. Kthellë	41.74	19.94	10%/10	0.087	0.224	0.127	0.066	0.03
			10%/50	0.142	0.37	0.232	0.125	0.059
4. Orosh	41.87	20.08	10%/10	0.093	0.23	0.125	0.063	0.029
			10%/50	0.144	0.383	0.217	0.11	0.054
5. Rrëshen	41.77	19.87	10%/10	0.094	0.237	0.132	0.069	0.031
			10%/50	0.154	0.402	0.245	0.129	0.062
6. Rubik	41.77	19.77	10%/10	0.114	0.28	0.152	0.078	0.034
			10%/50	0.208	0.507	0.304	0.157	0.072
7. Selitë	41.75	20.12	10%/10	0.085	0.218	0.121	0.061	0.026
			10%/50	0.127	0.35	0.206	0.107	0.053
26. PEQIN								
1. Gjoçaj	41.02	19.72	10%/10	0.142	0.34	0.181	0.09	0.038
			10%/50	0.274	0.647	0.377	0.194	0.083
2. Karinë	41.05	19.71	10%/10	0.142	0.34	0.181	0.09	0.038
			10%/50	0.274	0.647	0.377	0.194	0.083
3. Pajovë	41.05	19.83	10%/10	0.14	0.34	0.18	0.09	0.038
			10%/50	0.271	0.648	0.373	0.191	0.083
4. Peqin	41.03	19.73	10%/10	0.142	0.34	0.181	0.09	0.038
			10%/50	0.274	0.647	0.377	0.184	0.083
5. Përparim	41.04	19.79	10%/10	0.14	0.34	0.18	0.09	0.038
			10%/50	0.271	0.648	0.373	0.191	0.083
6. Shezë	41.01	19.81	10%/10	0.14	0.34	0.18	0.09	0.038
			10%/50	0.271	0.648	0.373	0.191	0.083
27. PËRMET								
1. Ballaban	40.42	20.12	10%/10	0.104	0.246	0.129	0.066	0.028
			10%/50	0.225	0.523	0.29	0.145	0.064
2. Çarçovë	40.11	20.55	10%/10	0.102	0.221	0.121	0.06	0.026
			10%/50	0.201	0.459	0.206	0.132	0.059
3. Frashër	40.37	20.43	10%/10	0.087	0.211	0.115	0.057	0.026
			10%/50	0.148	0.385	0.223	0.114	0.054
4. Dishnicë	40.34	20.21	10%/10	0.099	0.236	0.124	0.063	0.027
			10%/50	0.216	0.505	0.276	0.139	0.061
5. Këlcyrë	40.31	20.16	10%/10	0.108	0.21	0.088	0.066	0.028
			10%/50	0.234	0.459	0.202	0.149	0.065
6. Petran	40.21	20.40	10%/10	0.095	0.224	0.119	0.059	0.026

			10%/50	0.181	0.448	0.25	0.126	0.057
7. Përmet	40.23	20.31	10%/10 10%/50	0.098 0.21	0.233 0.497	0.122 0.271	0.061 0.135	0.027 0.06
8. Qendër Piskovë	40.28	20.27	10%/10 10%/50	0.099 0.182	0.22 0.441	0.118 0.247	0.059 0.126	0.026 0.057
9. Sukë	40.38	20.15	10%/10 10%/50	0.104 0.225	0.246 0.523	0.129 0.29	0.066 0.145	0.028 0.064
28. POGRADEC								
1. Buçimas	40.89	20.67	10%/10 10%/50	0.115 0.213	0.27 0.52	0.144 0.293	0.069 0.142	0.031 0.066
2. Çerravë	40.83	20.72	10%/10 10%/50	0.122 0.219	0.264 0.547	0.15 0.308	0.07 0.148	0.031 0.069
3. Dardhas	40.82	20.56	10%/10 10%/50	0.099 0.176	0.237 0.444	0.129 0.249	0.062 0.123	0.029 0.059
4. Hudenisht	41.04	20.61	10%/10 10%/50	0.115 0.212	0.272 0.521	0.145 0.293	0.069 0.142	0.031 0.067
5. Pogradec	40.90	20.65	10%/10 10%/50	0.115 0.213	0.27 0.52	0.144 0.293	0.069 0.142	0.031 0.066
6. Proptisht	40.95	20.50	10%/10 10%/50	0.1 0.177	0.242 0.448	0.131 0.252	0.063 0.124	0.029 0.059
7. Trebinjë	40.90	20.51	10%/10 10%/50	0.1 0.177	0.242 0.448	0.131 0.252	0.063 0.124	0.029 0.059
8. Velçan	40.94	20.45	10%/10 10%/50	0.085 0.133	0.22 0.377	0.12 0.216	0.059 0.109	0.026 0.054
29. PUKË								
1. Blerim	42.15	20.19	10%/10 10%/50	0.103 0.177	0.245 0.435	0.13 0.238	0.063 0.118	0.029 0.056
2. Fierzë	42.25	20.01	10%/10 10%/50	0.114 0.202	0.279 0.525	0.36 0.296	0.075 0.145	0.033 0.069
3. Fushë-Arrëz	42.07	20.00	10%/10 10%/50	0.102 0.16	0.253 0.442	0.137 0.251	0.069 0.126	0.031 0.062
4. Gjegjan	41.93	19.99	10%/10 10%/50	0.091 0.139	0.232 0.387	0.126 0.226	0.065 0.117	0.03 0.057
5. Iballë	42.18	20.01	10%/10 10%/50	0.114 0.202	0.279 0.525	0.36 0.296	0.075 0.145	0.033 0.069
6. Pukë	42.04	19.89	10%/10 10%/50	0.12 0.214	0.295 0.545	0.162 0.319	0.081 0.16	0.036 0.075
7. Qafë-Mali	42.09	20.07	10%/10 10%/50	0.114 0.202	0.279 0.525	0.152 0.269	0.075 0.145	0.033 0.069
8. Qelëz	42.09	19.90	10%/10 10%/50	0.134 0.245	0.319 0.617	0.178 0.36	0.087 0.18	0.038 0.082
9. Qerret	42.05	19.82	10%/10 10%/50	0.149 0.27	0.352 0.668	0.197 0.399	0.097 0.204	0.042 0.09
10. Rrapë	42.03	19.96	10%/10 10%/50	0.12 0.214	0.295 0.545	0.162 0.319	0.081 0.16	0.036 0.075
30. SARANDË								
1. Dhivër	39.84	20.17	10%/10 10%/50	0.116 0.242	0.269 0.565	0.137 0.318	0.069 0.159	0.028 0.069
2. Konispol	39.67	20.15	0.116 0.243	0.116 0.242	0.267 0.565	0.135 0.318	0.069 0.159	0.028 0.069
3. Ksamil	39.77	20.00	0.116 0.243	0.116 0.243	0.269 0.565	0.137 0.319	0.069 0.159	0.028 0.069
4. Livadhja	39.78	20.13	10%/10 10%/50	0.116 0.243	0.27 0.565	0.138 0.319	0.07 0.16	0.029 0.069

5. Lukovë	39.99	19.92	10%/10 10%/50	0.115 0.242	0.267 0.564	0.138 0.317	0.069 0.159	0.029 0.069
6. Markat	39.73	20.17	10%/10 10%/50	0.116 0.243	0.269 0.565	0.137 0.319	0.07 0.16	0.028 0.069
7. Sarandë	39.88	19.98	10%/10 10%/50	0.116 0.243	0.27 0.565	0.138 0.319	0.07 0.16	0.029 0.069
8. Xarë	39.73	20.06	10%/10 10%/50	0.116 0.243	0.268 0.565	0.138 0.318	0.069 0.159	0.028 0.069
31. SKRAPAR								
1. Bogovë	40.56	20.15	10%/10 10%/50	0.1 0.208	0.241 0.487	0.129 0.277	0.066 0.141	0.029 0.063
2. Çepan	40.41	20.27	10%/10 10%/50	0.085 0.155	0.209 0.392	0.114 0.227	0.058 0.117	0.026 0.054
3. Çorovodë	40.50	20.23	10%/10 10%/50	0.087 0.169	0.216 0.413	0.118 0.24	0.06 0.124	0.027 0.057
4. Gjerbës	40.63	20.24	10%/10 10%/50	0.085 0.157	0.213 0.39	0.117 0.231	0.06 0.121	0.027 0.056
5. Leshnjë	40.54	20.29	10%/10 10%/50	0.081 0.138	0.203 0.38	0.112 0.214	0.057 0.112	0.026 0.053
6. Poliçan	40.61	20.10	10%/10 10%/50	0.1 0.208	0.241 0.487	0.129 0.277	0.066 0.141	0.029 0.063
7. Potom	40.49	20.37	10%/10 10%/50	0.084 0.138	0.208 0.369	0.114 0.215	0.057 0.11	0.026 0.053
8. Qendër	40.48	20.27	10%/10 10%/50	0.081 0.138	0.203 0.36	0.112 0.214	0.057 0.112	0.026 0.053
9. Vendreshë	40.51	20.11	10%/10 10%/50	0.102 0.215	0.242 0.504	0.129 0.262	0.066 0.143	0.029 0.063
10. Zhepë	40.67	20.29	10%/10 10%/50	0.078 0.125	0.202 0.339	0.112 0.205	0.057 0.108	0.026 0.052
32. SHKODËR								
1. Ana e Malit	42.01	19.43	10%/10 10%/50	0.218 0.394	0.507 0.92	0.26 0.535	0.124 0.272	0.053 0.113
2. Barbullush	41.91	19.54	10%/10 10%/50	0.215 0.394	0.498 0.918	0.25 0.526	0.119 0.264	0.05 0.11
3. Bërdicë	42.02	19.49	10%/10 10%/50	0.207 0.377	0.48 0.885	0.245 0.51	0.118 0.257	0.05 0.108
4. Bushat	41.95	19.52	10%/10 10%/50	0.215 0.394	0.498 0.918	0.25 0.526	0.119 0.264	0.05 0.11
5. Dajç	41.99	19.39	10%/10 10%/50	0.218 0.394	0.507 0.92	0.26 0.535	0.124 0.272	0.053 0.113
6. Guri i Zi	42.04	19.57	10%/10 10%/50	0.19 0.348	0.443 0.824	0.232 0.478	0.112 0.241	0.048 0.104
7. Hajmel	41.94	19.64	10%/10 10%/50	0.199 0.373	0.46 0.873	0.231 0.493	0.111 0.245	0.047 0.104
8. Postribë	42.13	19.60	10%/10 10%/50	0.151 0.268	0.366 0.66	0.202 0.397	0.101 0.206	0.043 0.091
9. Pult	42.27	19.70	10%/10 10%/50	0.09 0.139	0.193 0.333	0.089 0.16	0.087 0.122	0.03 0.06
10. Rrethinat	42.10	19.51	10%/10 10%/50	0.167 0.309	0.401 0.734	0.214 0.432	0.106 0.222	0.045 0.097
11. Shalë	42.31	19.82	10%/10 10%/50	0.1 0.166	0.243 0.452	0.135 0.256	0.069 0.128	0.031 0.062
12. Shkodër	42.05	19.53	10%/10 10%/50	0.207 0.377	0.48 0.885	0.245 0.51	0.118 0.257	0.05 0.108
13. Shllak	42.09	19.75	10%/10	0.145	0.345	0.196	0.096	0.042

			10%/50	0.261	0.657	0.391	0.2	0.089
14. Shosh	42.25	19.80	10%/10	0.126	0.303	0.169	0.084	0.037
			10%/50	0.229	0.58	0.338	0.17	0.078
15. Temal	42.16	19.82	10%/10	0.145	0.345	0.196	0.096	0.042
			10%/50	0.261	0.657	0.391	0.2	0.089
16. Vau Dejes	42.01	19.62	10%/10	0.19	0.443	0.232	0.112	0.048
			10%/50	0.346	0.824	0.478	0.241	0.104
17. Velipojë	41.87	19.41	10%/10	0.22	0.508	0.258	0.123	0.052
			10%/50	0.397	0.926	0.536	0.272	0.112
18. Vig Mnellë	41.93	19.73	10%/10	0.167	0.398	0.202	0.101	0.043
			10%/50	0.324	0.769	0.433	0.218	0.094
33. TEPELENË								
1. Buz	40.44	19.99	10%/10	0.113	0.264	0.137	0.07	0.03
			10%/50	0.24	0.558	0.312	0.156	0.068
2. Krahës	40.47	19.86	10%/10	0.125	0.295	0.152	0.077	0.032
			10%/50	0.254	0.593	0.34	0.172	0.074
3. Kurvelesh	40.21	19.86	10%/10	0.114	0.263	0.136	0.069	0.029
			10%/50	0.241	0.56	0.314	0.157	0.068
4. Lopës	40.37	19.83	10%/10	0.119	0.279	0.145	0.074	0.031
			10%/50	0.245	0.572	0.326	0.164	0.071
5. Luftinjë	40.43	19.95	10%/10	0.118	0.275	0.143	0.073	0.03
			10%/50	0.245	0.57	0.323	0.162	0.07
6. Memaliaj fshat	40.34	19.94	10%/10	0.116	0.269	0.139	0.071	0.03
			10%/50	0.242	0.565	0.318	0.159	0.069
7. Memaliaj	40.35	19.98	10%/10	0.113	0.264	0.136	0.069	0.029
			10%/50	0.241	0.56	0.313	0.156	0.068
8. Qendër	40.29	19.98	10%/10	0.113	0.264	0.136	0.069	0.029
			10%/50	0.241	0.56	0.313	0.156	0.068
9. Qesarat	40.38	19.88	10%/10	0.119	0.279	0.145	0.074	0.031
			10%/50	0.245	0.572	0.326	0.164	0.071
10. Tepelenë	40.30	19.97	10%/10	0.113	0.264	0.136	0.069	0.029
			10%/50	0.241	0.56	0.313	0.156	0.068
34. TIRANË								
1. Baldushk	41.21	19.78	10%/10	0.138	0.333	0.177	0.088	0.038
			10%/50	0.262	0.635	0.363	0.185	0.081
2. Bërxullë	41.37	19.69	10%/10	0.129	0.309	0.164	0.083	0.036
			10%/50	0.26	0.609	0.349	0.178	0.077
3. Bërzhitë	41.24	19.89	10%/10	0.139	0.34	0.184	0.091	0.04
			10%/50	0.256	0.642	0.371	0.189	0.084
4. Dajt	41.38	19.91	10%/10	0.104	0.262	0.144	0.074	0.033
			10%/50	0.186	0.471	0.279	0.144	0.067
5. Farkë	41.31	19.88	10%/10	0.12	0.301	0.162	0.081	0.036
			10%/50	0.217	0.55	0.32	0.162	0.075
6. Kamëz	41.38	19.76	10%/10	0.116	0.264	0.154	0.078	0.034
			10%/50	0.23	0.547	0.316	0.161	0.072
7. Kashar	41.35	19.70	10%/10	0.134	0.324	0.171	0.086	0.037
			10%/50	0.267	0.629	0.361	0.184	0.08
8 Krrabë	41.20	19.95	10%/10	0.139	0.34	0.184	0.091	0.04
			10%/50	0.256	0.642	0.371	0.189	0.084
9. Ndroq	41.25	19.65	10%/10	0.14	0.335	0.177	0.089	0.037
			10%/50	0.274	0.644	0.375	0.192	0.082
10. Paskuqan	41.35	19.80	10%/10	0.126	0.311	0.165	0.083	0.036
			10%/50	0.248	0.595	0.341	0.173	0.077
11. Petrelë	41.24	19.85	10%/10	0.138	0.333	0.177	0.088	0.038
			10%/50	0.262	0.635	0.363	0.185	0.081

12. Pezë	41.22	19.68	10%/10 10%/50	0.139 0.271	0.335 0.642	0.177 0.371	0.089 0.19	0.038 0.082
13. Prezë	41.42	19.65	10%/10 10%/50	0.136 0.271	0.323 0.635	0.171 0.366	0.086 0.187	0.037 0.08
14. Shëngjergj	41.34	20.09	10%/10 10%/50	0.122 0.212	0.308 0.556	0.168 0.326	0.084 0.165	0.037 0.077
15. Tiranë	41.32	19.81	10%/10 10%/50	0.126 0.248	0.311 0.595	0.165 0.341	0.083 0.173	0.036 0.077
16. Vaqarr	41.29	19.74	10%/10 10%/50	0.134 0.267	0.324 0.629	0.171 0.361	0.086 0.184	0.037 0.08
17. Vorë	41.39	19.63	10%/10 10%/50	0.136 0.271	0.323 0.635	0.171 0.366	0.086 0.187	0.037 0.08
18. Zall-Bastar	41.44	19.91	10%/10 10%/50	0.104 0.186	0.262 0.471	0.144 0.279	0.074 0.144	0.033 0.067
19. Zall-Herr	41.39	19.81	10%/10 10%/50	0.116 0.23	0.284 0.547	0.154 0.316	0.078 0.161	0.034 0.072
35. TROPOJË								
1. Bajram Curri	42.40	20.02	10%/10 10%/50	0.106 0.202	0.249 0.515	0.133 0.282	0.064 0.134	0.029 0.063
2. Bujan	42.32	20.05	10%/10 10%/50	0.126 0.244	0.296 0.609	0.18 0.345	0.077 0.187	0.034 0.076
3. Bytyç	42.26	20.16	10%/10 10%/50	0.11 0.199	0.268 0.517	0.142 0.284	0.069 0.136	0.031 0.065
4. Fierzë	42.26	20.03	10%/10 10%/50	0.127 0.24	0.303 0.604	0.164 0.343	0.08 0.168	0.035 0.077
5. Lekbibaj	42.28	19.92	10%/10 10%/50	0.114 0.215	0.273 0.546	0.149 0.307	0.074 0.149	0.033 0.07
6. Llugaj	42.34	20.11	10%/10 10%/50	0.123 0.238	0.288 0.594	0.154 0.334	0.073 0.161	0.032 0.073
7. Margegaj	42.36	20.08	10%/10 10%/50	0.123 0.238	0.288 0.594	0.154 0.334	0.073 0.161	0.032 0.073
8. Tropojë Fshat	42.40	20.13	10%/10 10%/50	0.119 0.237	0.273 0.585	0.145 0.33	0.069 0.157	0.03 0.071
36. VLORË								
1. Armen	40.53	19.60	10%/10 10%/50	0.124 0.252	0.291 0.588	0.15 0.337	0.076 0.171	0.031 0.073
2. Brataj	40.27	19.65	10%/10 10%/50	0.109 0.234	0.249 0.543	0.13 0.302	0.067 0.151	0.028 0.065
3. Himarë	40.10	19.75	10%/10 10%/50	0.108 0.233	0.247 0.54	0.128 0.301	0.065 0.15	0.027 0.065
4. Horë Vranisht	40.21	19.65	10%/10 10%/50	0.11 0.235	0.252 0.546	0.131 0.304	0.067 0.152	0.028 0.066
5. Kotë	40.39	19.61	10%/10 10%/50	0.116 0.242	0.269 0.565	0.139 0.319	0.071 0.16	0.03 0.069
6. Novoselë	40.61	19.45	10%/10 10%/50	0.123 0.258	0.288 0.6	0.146 0.338	0.074 0.17	0.03 0.073
7. Oriku	40.31	19.46	10%/10 10%/50	0.1 0.218	0.223 0.508	0.12 0.279	0.062 0.141	0.026 0.061
8. Qendër	40.48	19.52	10%/10 10%/50	0.121 0.249	0.281 0.581	0.144 0.33	0.073 0.166	0.03 0.072
9. Selenicë	40.52	19.62	10%/10 10%/50	0.124 0.252	0.291 0.588	0.15 0.337	0.076 0.171	0.031 0.073
10. Sevaster	40.39	19.70	10%/10 10%/50	0.119 0.244	0.276 0.57	0.143 0.324	0.073 0.163	0.03 0.071
11. Shushicë	40.55	19.51	10%/10	0.121	0.281	0.144	0.073	0.03

			10%/50	0.249	0.581	0.33	0.166	0.072
12. Vllahinë	40.45	19.63	10%/10	0.116	0.269	0.139	0.071	0.03
			10%/50	0.242	0.565	0.319	0.16	0.069
13. Vlorë	40.46	19.48	10%/10	0.121	0.281	0.144	0.073	0.03
			10%/50	0.249	0.581	0.33	0.166	0.072

Table 2. Full spectral values (Sa (g)) for 36 towns of Albania with probability 10%/10 years (95 years return period) and 10%/50 years (475 years return period) on rock site conditions.

City	Coordinates		Probabil.	Periods (sec)							
	N	E		0.1	0.2	0.3	0.4	0.5	0.75	1.0	2.0
Bajram Curri	42.40	20.02	10%/10	0.221	0.249	0.206	0.166	0.133	0.088	0.064	0.029
			10%/50	0.5	0.515	0.423	0.347	0.282	0.186	0.134	0.063
Ballsh	40.59	19.72	10%/10	0.278	0.315	0.261	0.211	0.163	0.109	0.082	0.034
			10%/50	0.551	0.624	0.535	0.447	0.36	0.243	0.183	0.078
Berat	40.71	19.94	10%/10	0.274	0.309	0.255	0.206	0.16	0.107	0.08	0.034
			10%/50	0.551	0.62	0.529	0.44	0.353	0.238	0.178	0.076
Bilisht	40.63	20.98	10%/10	0.216	0.242	0.199	0.159	0.127	0.082	0.058	0.026
			10%/50	0.469	0.489	0.405	0.333	0.271	0.179	0.129	0.059
Bulqizë	41.49	20.23	10%/10	0.229	0.259	0.215	0.175	0.14	0.094	0.069	0.032
			10%/50	0.427	0.449	0.373	0.31	0.252	0.189	0.126	0.063
Burrel	41.60	19.97	10%/10	0.177	0.214	0.181	0.148	0.121	0.083	0.063	0.029
			10%/50	0.296	0.342	0.299	0.253	0.212	0.145	0.113	0.055
Çorovodë	40.50	20.23	10%/10	0.184	0.216	0.181	0.147	0.118	0.08	0.06	0.027
			10%/50	0.36	0.413	0.353	0.296	0.24	0.164	0.124	0.057
Delvinë	39.95	20.05	10%/10	0.237	0.268	0.222	0.177	0.136	0.092	0.069	0.026
			10%/50	0.505	0.565	0.481	0.398	0.318	0.215	0.159	0.069
Durrës	41.31	19.41	10%/10	0.277	0.313	0.259	0.21	0.163	0.11	0.083	0.035
			10%/50	0.554	0.626	0.536	0.446	0.359	0.243	0.183	0.078
Elbasan	41.12	20.05	10%/10	0.338	0.375	0.314	0.258	0.21	0.137	0.102	0.044
			10%/50	0.697	0.727	0.617	0.524	0.435	0.3	0.222	0.098
Ersekë	40.34	20.66	10%/10	0.22	0.249	0.206	0.169	0.135	0.09	0.066	0.029
			10%/50	0.484	0.508	0.424	0.353	0.29	0.195	0.141	0.064
Fier	40.73	19.53	10%/10	0.283	0.32	0.265	0.214	0.165	0.11	0.083	0.034
			10%/50	0.56	0.634	0.543	0.454	0.366	0.247	0.186	0.079
Gramsh	40.86	20.19	10%/10	0.182	0.217	0.182	0.149	0.12	0.082	0.061	0.028
			10%/50	0.322	0.373	0.323	0.273	0.225	0.154	0.118	0.056
Gjirokastrë	40.07	20.08	10%/10	0.238	0.269	0.222	0.178	0.137	0.093	0.07	0.029
			10%/50	0.505	0.565	0.481	0.398	0.318	0.215	0.159	0.069
Kavajë	41.18	19.56	10%/10	0.293	0.33	0.275	0.222	0.173	0.115	0.087	0.037
			10%/50	0.564	0.641	0.55	0.461	0.372	0.252	0.191	0.081
Korçë	40.61	20.79	10%/10	0.254	0.28	0.229	0.185	0.147	0.096	0.069	0.03
			10%/50	0.534	0.547	0.454	0.376	0.308	0.205	0.147	0.068
Koplik	42.21	19.44	10%/10	0.313	0.356	0.301	0.245	0.196	0.129	0.1	0.042
			10%/50	0.569	0.651	0.584	0.48	0.394	0.271	0.207	0.09
Krujë	41.51	19.76	10%/10	0.257	0.295	0.246	0.202	0.159	0.107	0.081	0.035
			10%/50	0.519	0.583	0.501	0.416	0.336	0.229	0.172	0.075
Krumë	42.18	20.42	10%/10	0.179	0.209	0.168	0.134	0.109	0.071	0.051	0.024
			10%/50	0.332	0.356	0.291	0.235	0.19	0.122	0.091	0.045
Kuçovë	40.79	19.92	10%/10	0.276	0.312	0.258	0.21	0.163	0.109	0.082	0.044

			10%/50	0.549	0.617	0.527	0.438	0.352	0.238	0.178	0.077
Kukës	42.05	20.40	10%/10	0.245	0.272	0.223	0.18	0.143	0.094	0.068	0.03
			10%/50	0.475	0.491	0.404	0.331	0.268	0.176	0.128	0.06
Laç	41.62	19.71	10%/10	0.25	0.269	0.243	0.2	0.157	0.107	0.081	0.035
			10%/50	0.491	0.558	0.482	0.405	0.329	0.225	0.17	0.075
Lezhë	41.78	19.62	10%/10	0.374	0.412	0.338	0.271	0.211	0.137	0.103	0.043
			10%/50	0.713	0.788	0.673	0.557	0.45	0.305	0.227	0.097
Librazhd	41.18	20.32	10%/10	0.316	0.344	0.285	0.233	0.189	0.123	0.09	0.04
			10%/50	0.65	0.66	0.551	0.464	0.384	0.26	0.193	0.088
Lushnjë	40.93	19.66	10%/10	0.298	0.336	0.281	0.227	0.178	0.118	0.089	0.037
			10%/50	0.596	0.644	0.554	0.466	0.377	0.256	0.194	0.083
Peqin	41.03	19.73	10%/10	0.303	0.34	0.264	0.23	0.181	0.119	0.09	0.038
			10%/50	0.571	0.647	0.554	0.465	0.377	0.256	0.184	0.083
Peshkopi	41.69	20.43	10%/10	0.282	0.306	0.251	0.205	0.162	0.106	0.077	0.035
			10%/50	0.526	0.537	0.444	0.366	0.3	0.2	0.143	0.069
Përmet	40.23	20.31	10%/10	0.206	0.233	0.194	0.155	0.122	0.082	0.061	0.027
			10%/50	0.448	0.497	0.415	0.34	0.271	0.182	0.135	0.06
Pogradec	40.90	20.65	10%/10	0.241	0.27	0.222	0.181	0.144	0.095	0.069	0.031
			10%/50	0.503	0.52	0.432	0.357	0.293	0.195	0.142	0.066
Pukë	42.04	19.89	10%/10	0.259	0.295	0.246	0.204	0.162	0.109	0.081	0.036
			10%/50	0.513	0.545	0.461	0.387	0.319	0.217	0.16	0.075
Rrëshen	41.77	19.87	10%/10	0.203	0.237	0.202	0.164	0.132	0.091	0.069	0.031
			10%/50	0.346	0.402	0.348	0.297	0.245	0.17	0.129	0.062
Sarandë	39.88	19.98	10%/10	0.238	0.27	0.223	0.179	0.138	0.093	0.07	0.029
			10%/50	0.505	0.565	0.482	0.399	0.319	0.216	0.16	0.069
Shkodër	42.05	19.53	10%/10	0.438	0.48	0.395	0.317	0.245	0.159	0.118	0.05
			10%/50	0.802	0.885	0.754	0.628	0.51	0.344	0.257	0.108
Tepelenë	40.30	19.97	10%/10	0.234	0.264	0.219	0.175	0.136	0.092	0.069	0.029
			10%/50	0.503	0.56	0.475	0.392	0.313	0.211	0.156	0.068
Tiranë	41.32	19.81	10%/10	0.275	0.311	0.258	0.211	0.165	0.111	0.083	0.036
			10%/50	0.537	0.595	0.508	0.422	0.341	0.231	0.173	0.077
Vlorë	40.46	19.48	10%/10	0.248	0.281	0.232	0.187	0.144	0.098	0.073	0.03
			10%/50	0.517	0.581	0.497	0.412	0.33	0.223	0.166	0.072

ANNEX II

Maps and graphics figure captions for seismic hazard of albania

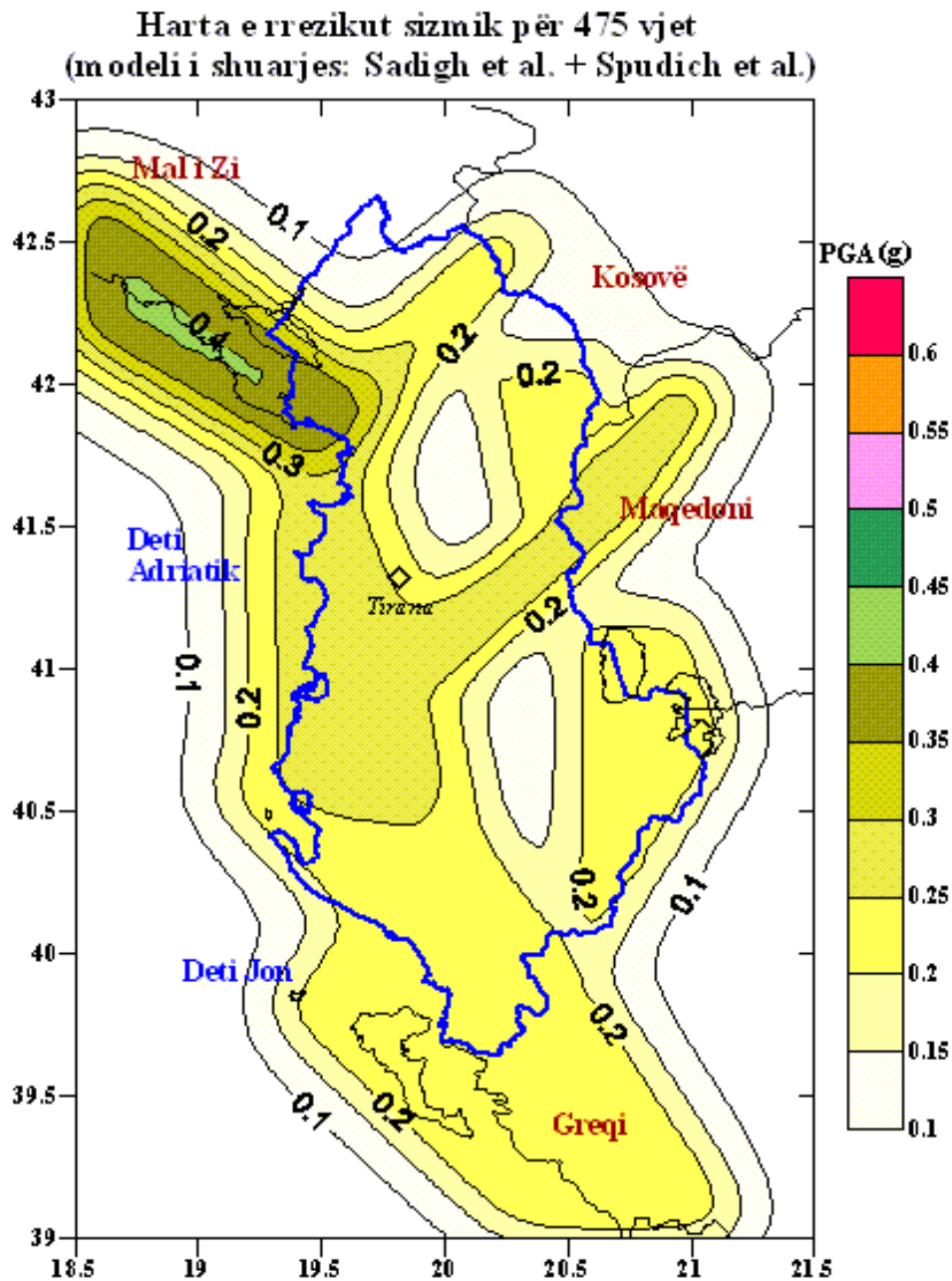


Figura 1. Harta e shpejtimit maksimal për Shqipërinë, në truall shkëmbor dhe për probabilitet 10% / 50 vjet ose 475 vjet periudhë përsëritje.

Figure 1. Map of PGA for Albania on rock site and for probability 10 % / 50 years or 475 years return period.

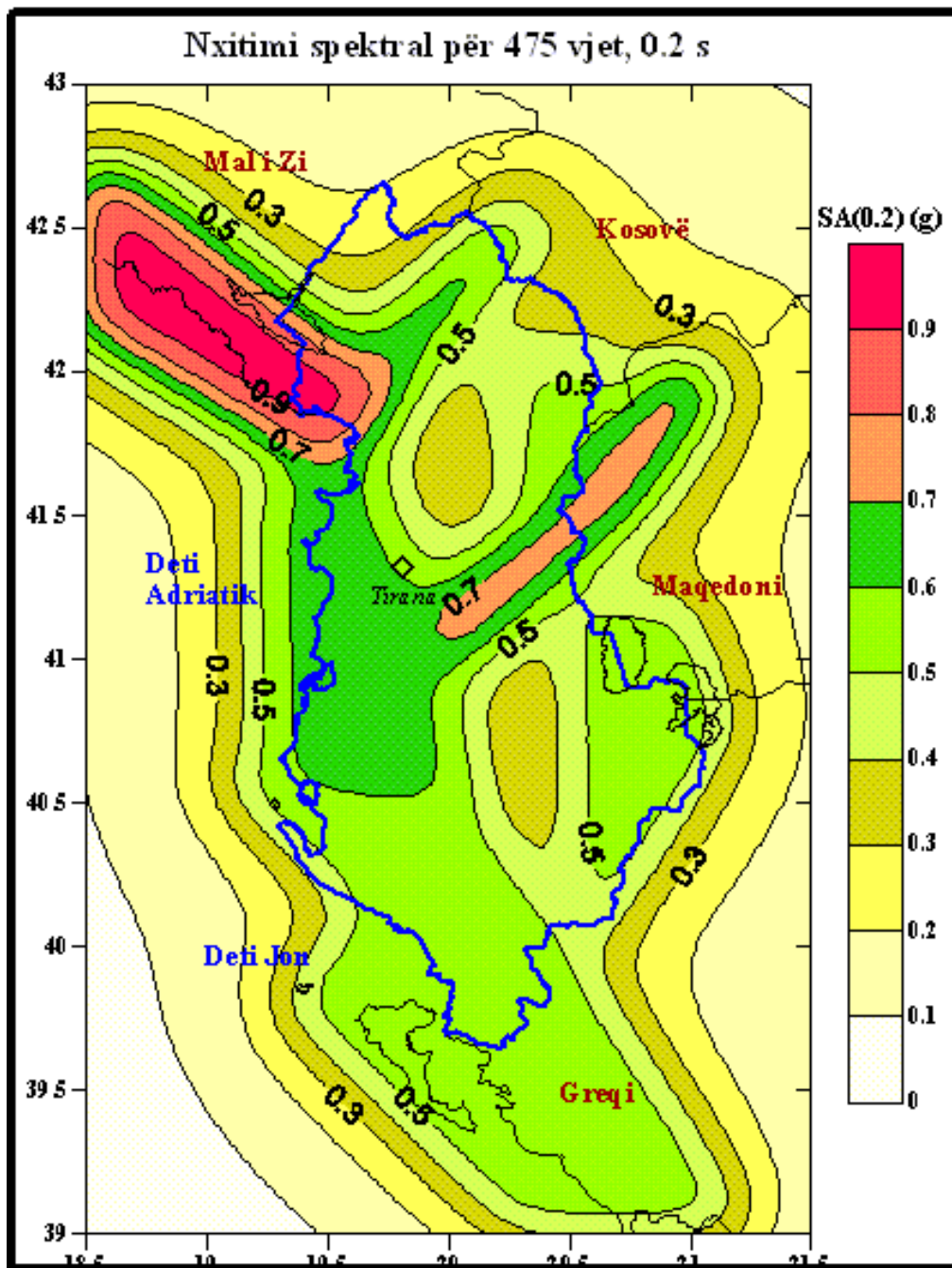


Figura 3. Harta e shpejtimit spektral $S_a(0.2)$ me shuarje 5% për Shqipërinë, në truall shkëmbor dhe për probabilitet 10% /50 vjet ose 475 vjet periudhë përsëritje.

Figure 3. Map of $S_a(0.2)$ 5 % damping for Albania on rock site and for probability 10 % / 50 years or 475 years return period.

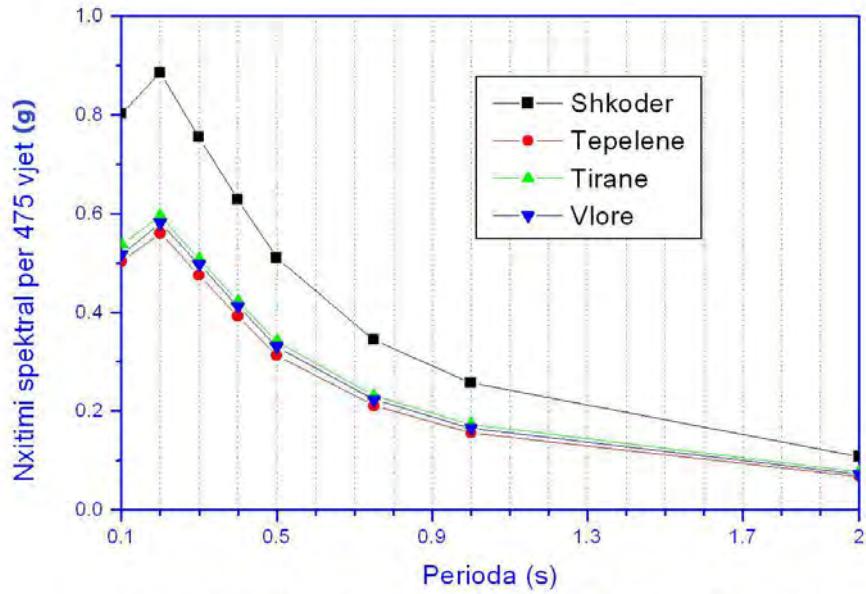


Figura 29. Spektrot e rrezikut uniform për qytetet Shkodër, Tepelenë, Tiranë e Vlorë, për probabilitet 10% / 50 vjet ose 475 vjet periudhë përsëritje.

Figure 29. Uniform hazard spectra for Shkodër, Tepelenë, Tiranë and Vlorë towns for probability 10 % / 50 years or 475 years return period.

Other figures on the text:

First part:

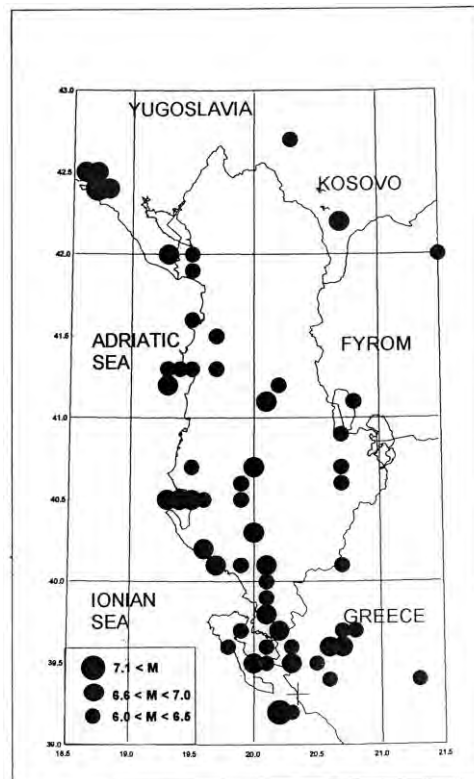


FIG.I.1 - Epicenters of earthquakes of Albania for the period 58-1900 ($M_s > 6.0$).



FIG.I.2 - Valona, Albania earthquake, Oct. 12, 185. Coastal portion of town damaged. Fire. (Jan Kozak Collection: KZ268, Pacific Earthquake Engineering Research (PEER) Center, University of Berkeley, California, USA).

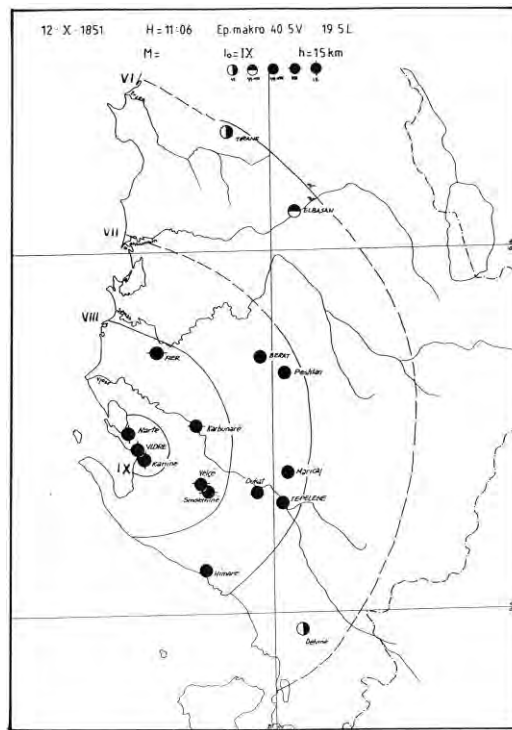


FIG.I.3 - Iseiseismal map of October 12, 1851 earthquake (Sulstarova et al., 1980).

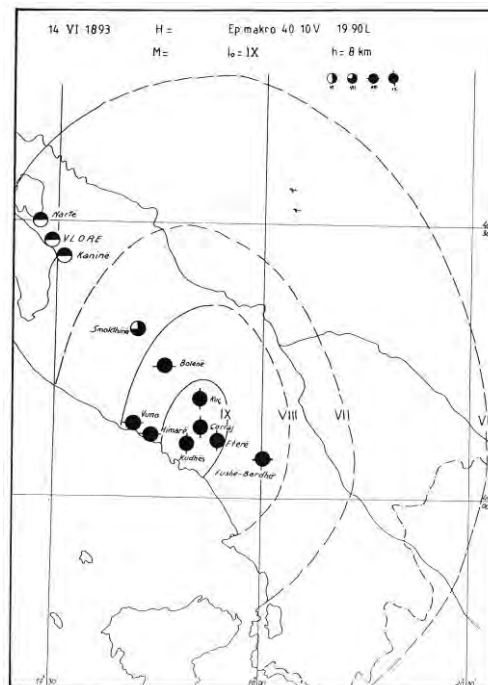


FIG.I.4 - Iseiseismal map of June 14, 1893 earthquake.

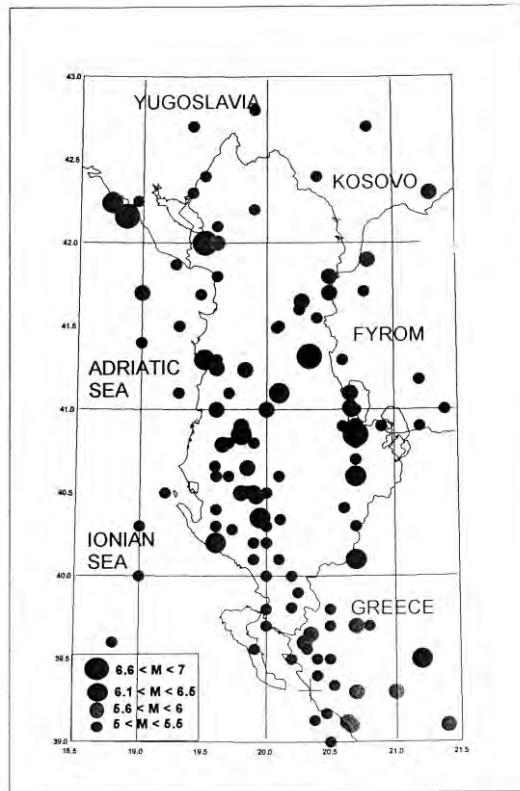


FIG.I.5 - The epicenters of earthquakes of Albania for the period 1901-2005 ($M_S > 5$).

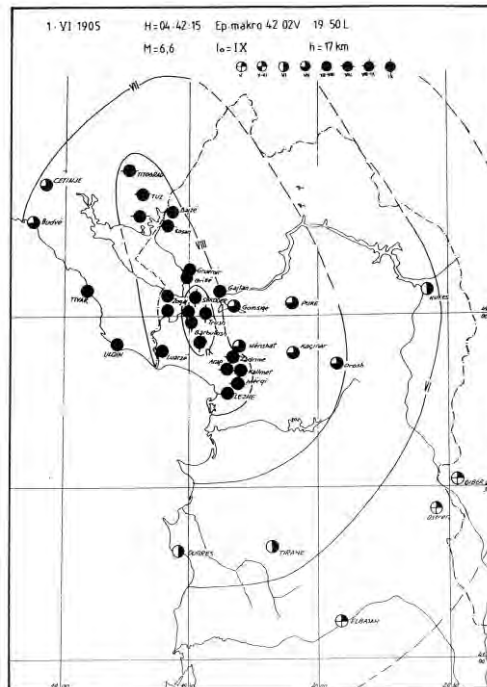


FIG.I.6 - Isoseismal map of June 1, 1905 earthquake.

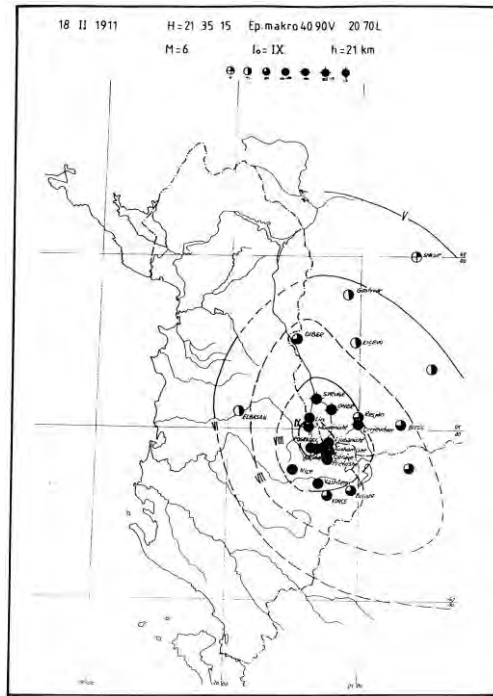


FIG.I.7 - Isoseismal map of February 18, 1911 earthquake.



FIG.I.8 - Photo of the time shot after the earthquake of Tepelena, November 26, 1920 (Archive of Library of Congress, Washington DC, USA).

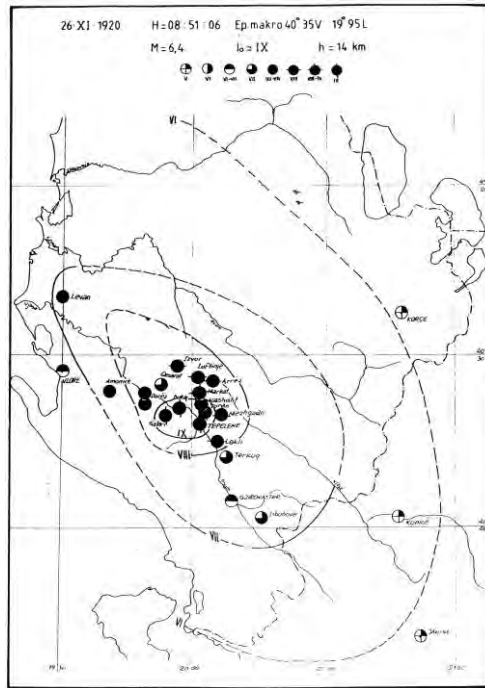


FIG.I.9 - Iseseismal map of November 26, 1920 earthquake.

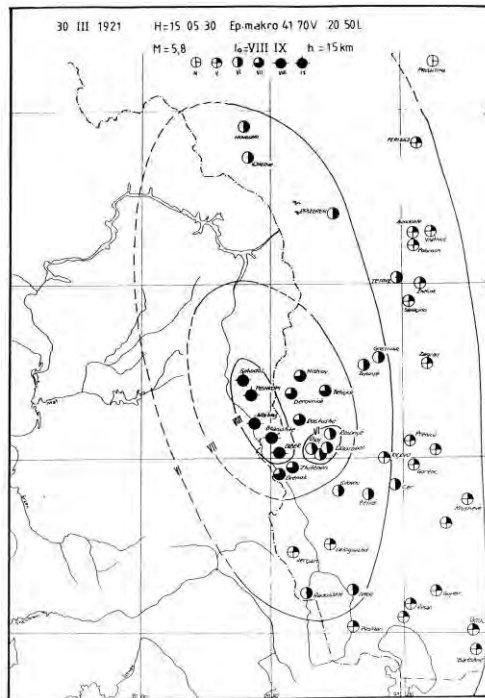


FIG.I.10 - Iseseismal map of March 30, 1921 earthquake.

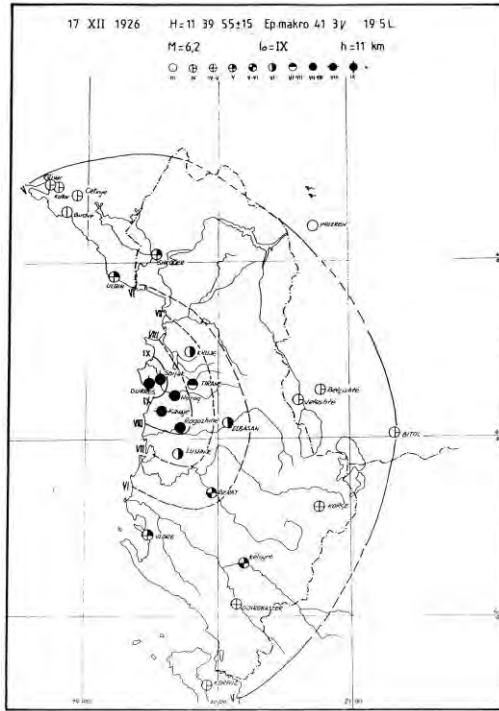


FIG.I.11 - Isoseismal map of Decembre17, 1926 earthquake.

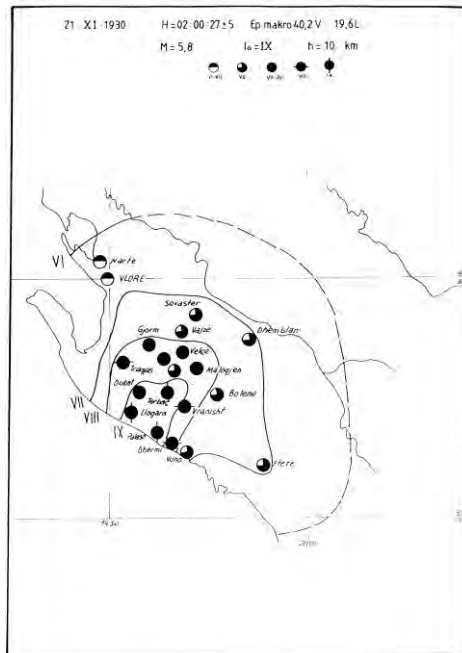


FIG I.12 - Isoseismal map of November 21, 1930 earthquake.

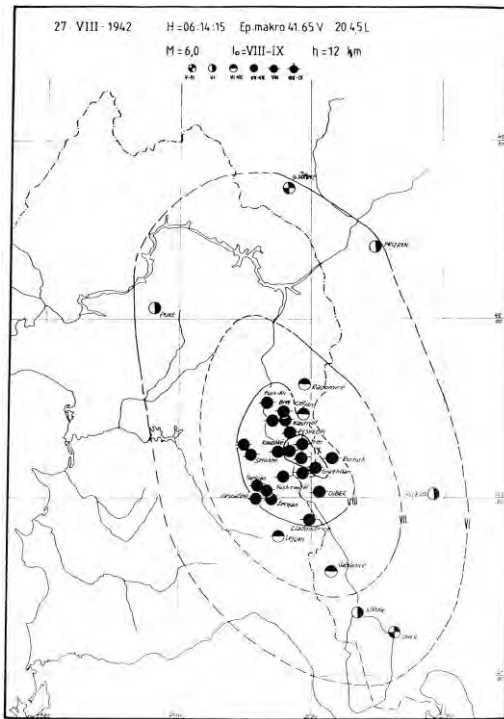


FIG.I.13 - Isoseismal map of August 27, 1942 earthquake.

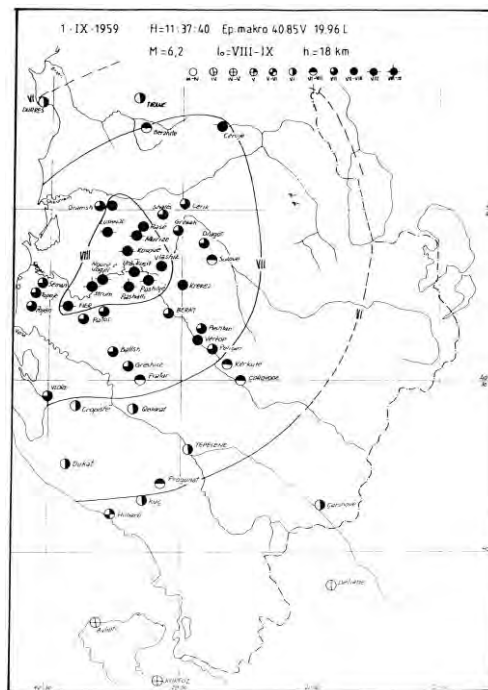


FIG.I.14 - Isoseismal map of September 1, 1959 earthquake.

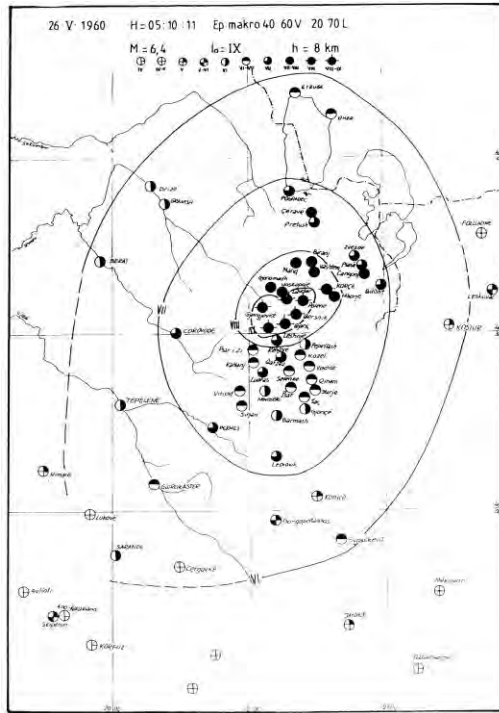


FIG.I.15 - Isoseismal map of May 26, 1960 earthquake.

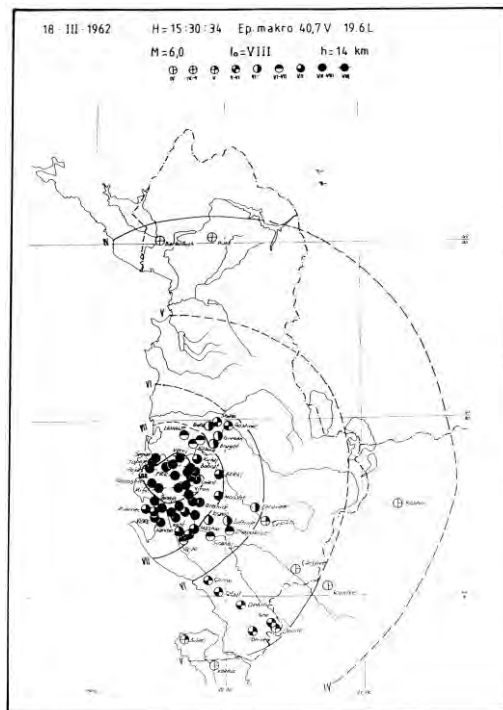


FIG.I.16 - Isoseismal map of March 18, 1962 earthquake.

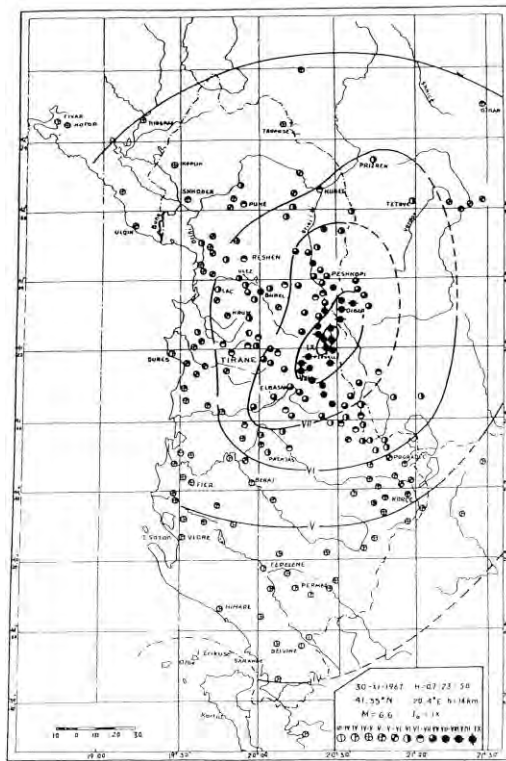


FIG.I.17 - Isoseismal map of November 30, 1967 earthquake.

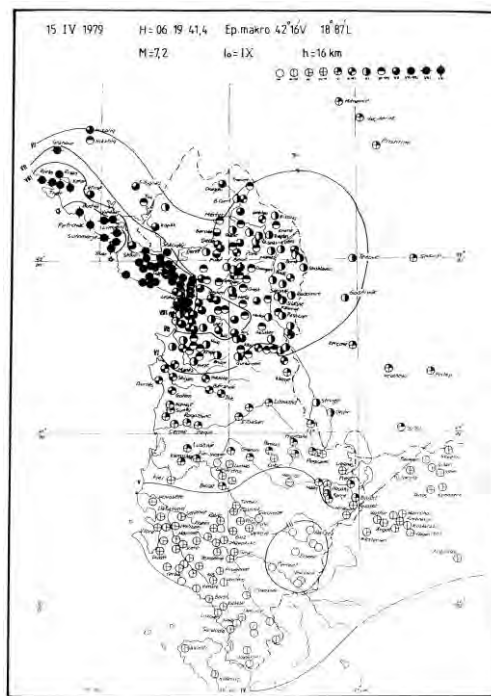


FIG.I.18 - Isoseismal map of April 15, 1979 earthquake.

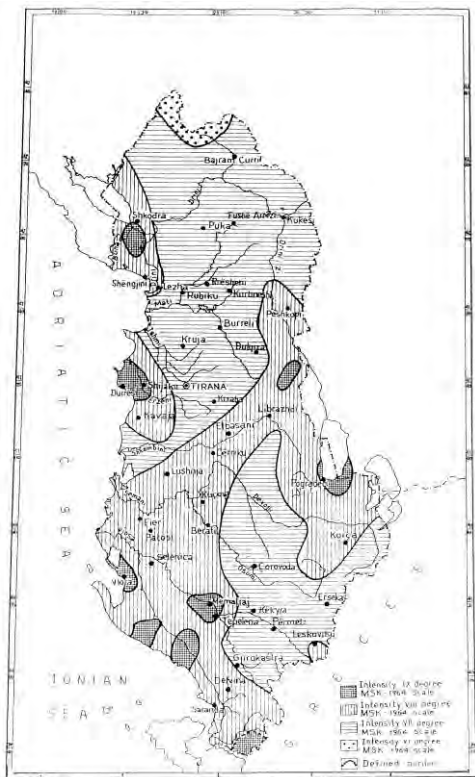
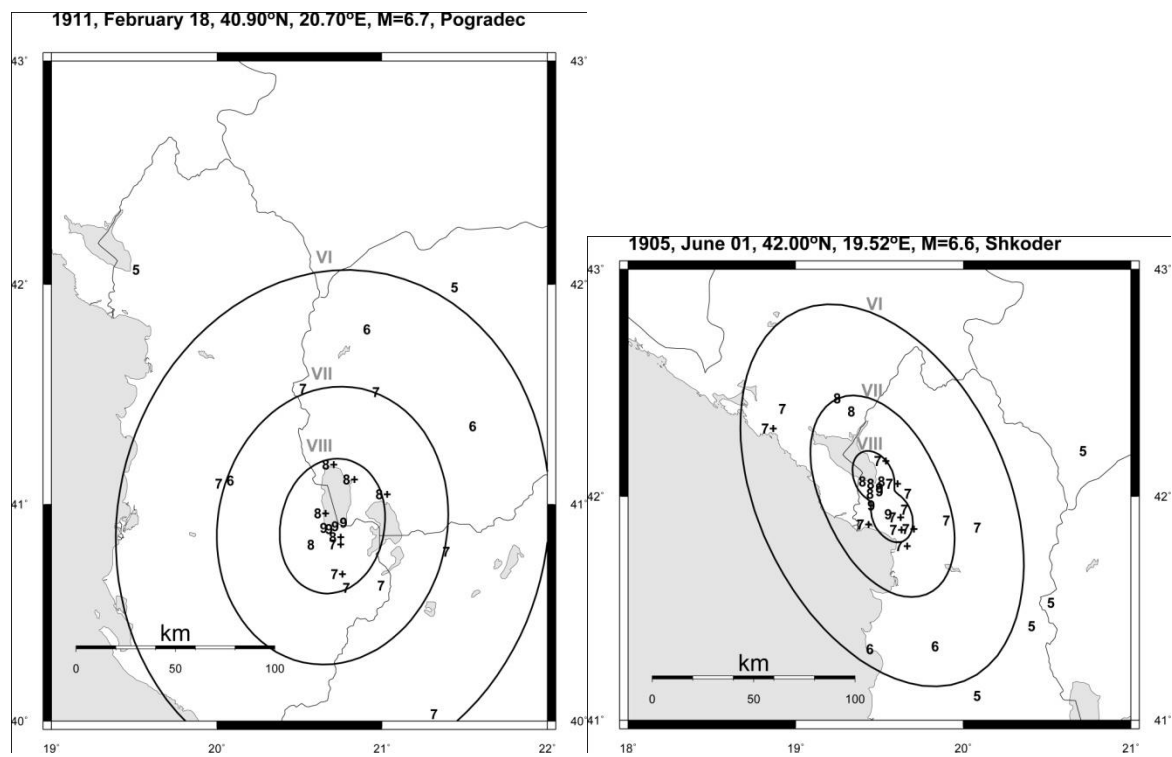


FIG.I.20 - Map of the maximum observed intensities for the period 1800-2005.



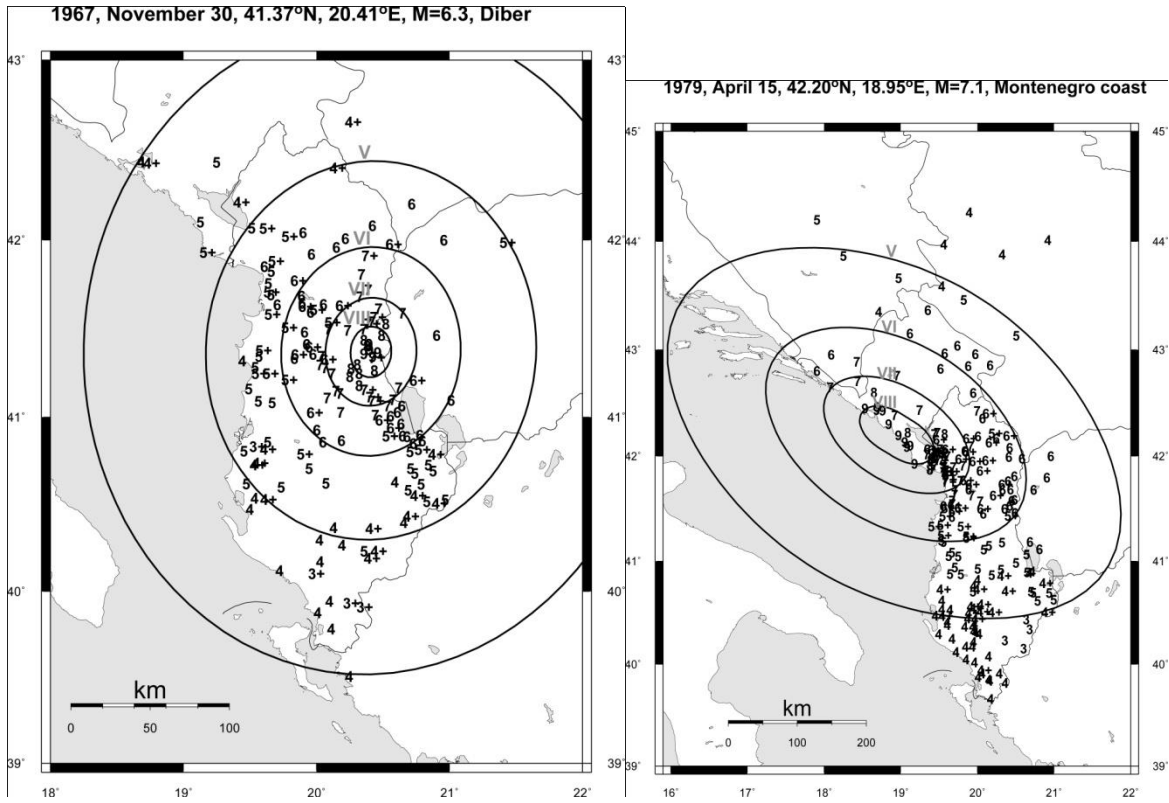


FIG.I.19 - Isoseismal maps from Atlas of isoseimal of shallow earthquakes of (Papazachos etj., 2001).

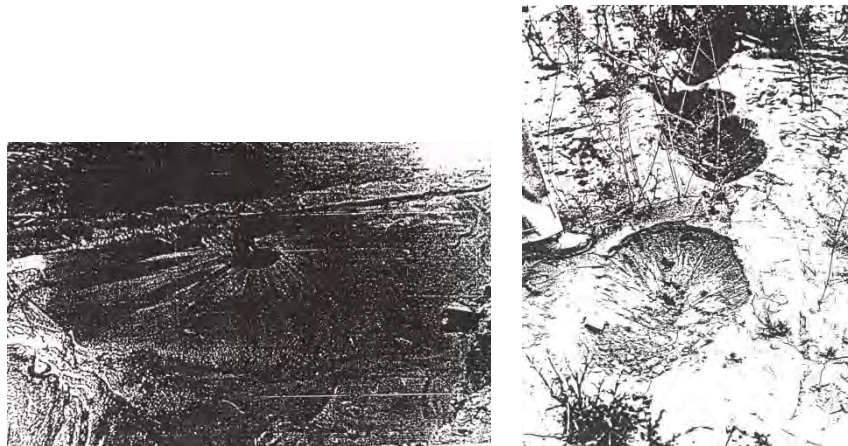


FIG.I.21 - Fountains od water and sand in the epicentral zone of earthquake of September 1, 1959, (M=6.4).



FIG.I.22 - Phenomena of horizontal displacement in Tivari port (Montenegro).



FIG.I.23 - Sand fountains during the earthquake of April 15, 1979.

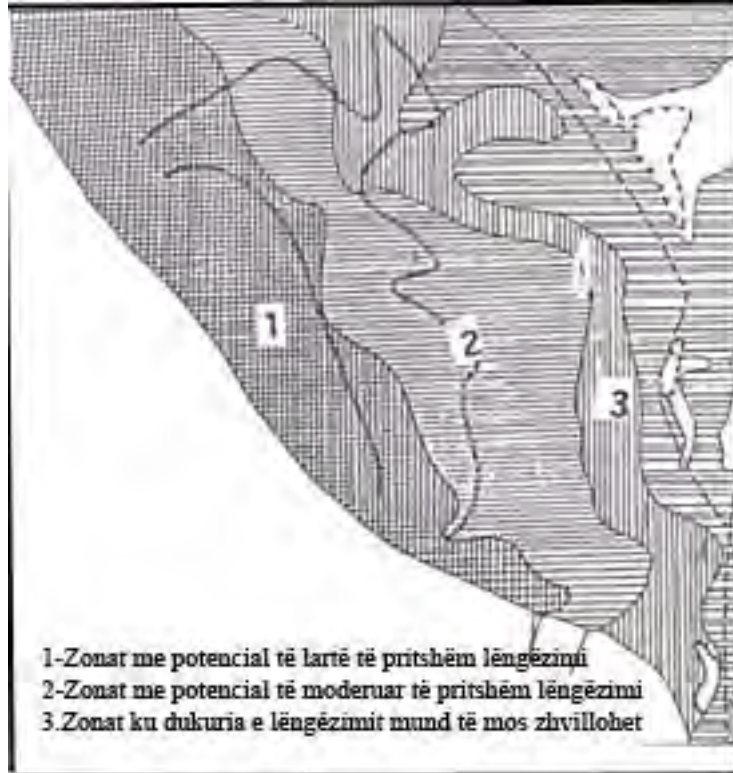


FIG.I.24 - Map of assessment of potential liquefaction for city of Vlora.

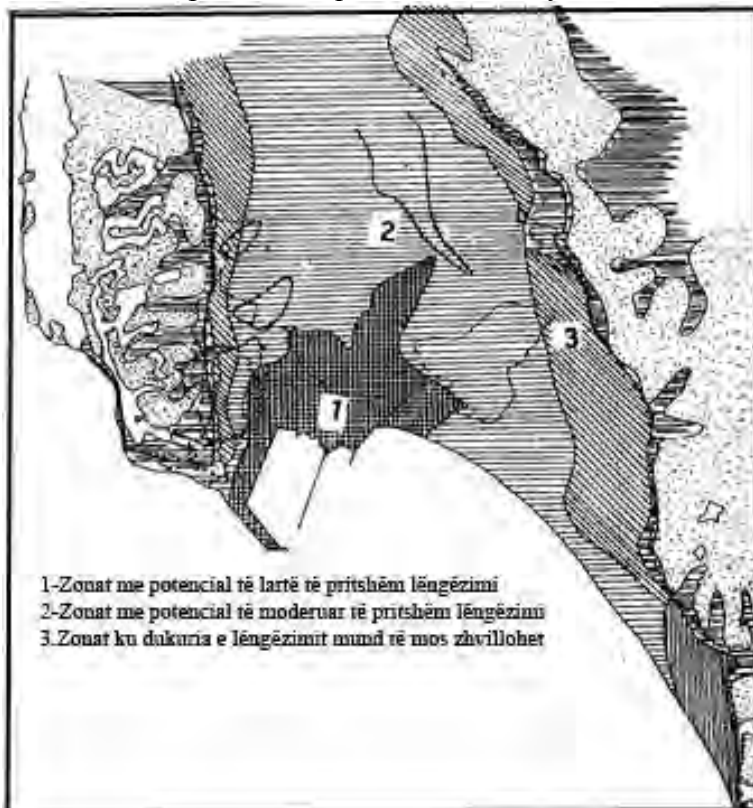


FIG.I.25 - Map of assessment of potential liquefaction for city of Durres.

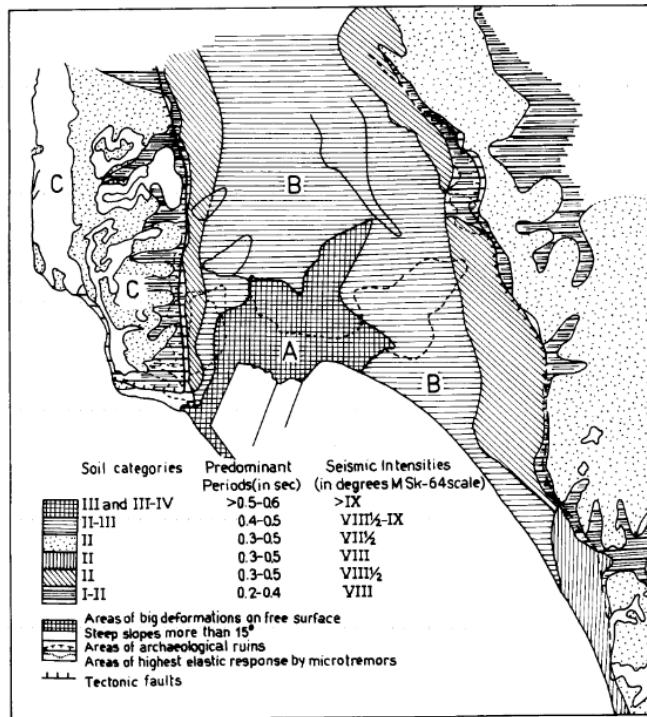


FIG.I.26 - Microzonation map of city of Durrës expressed through seismic intensity in degree (MSK-64).

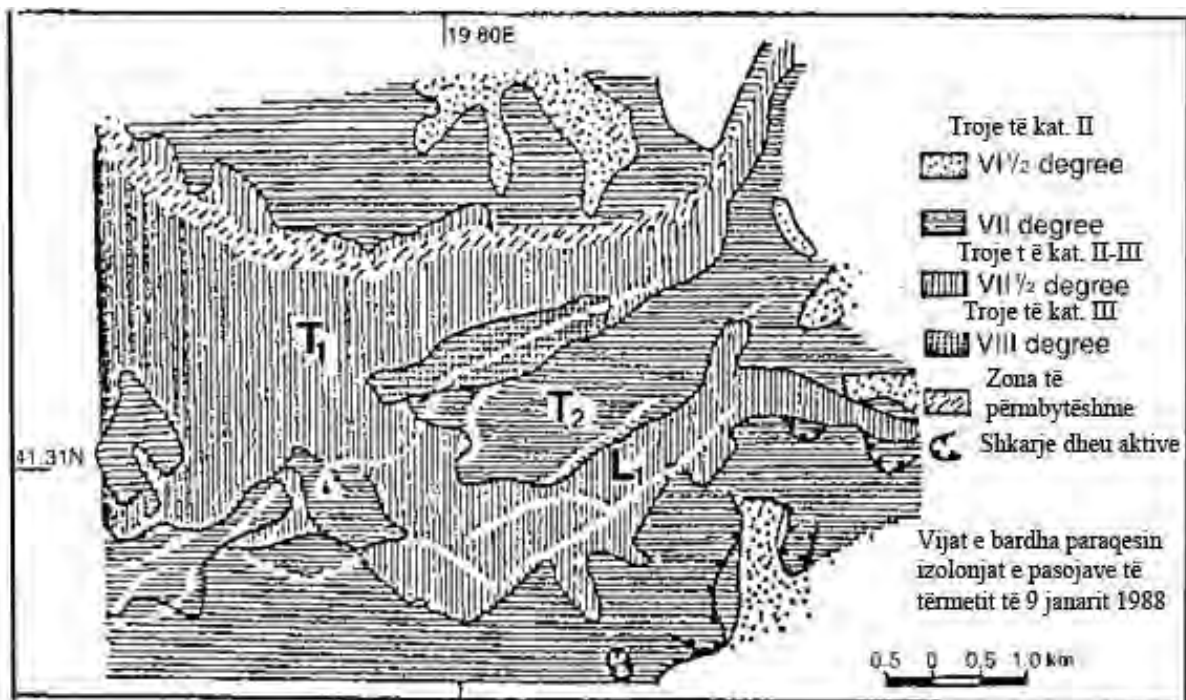


FIG.I.27 - Microzonation map of city of Tirana expressed through seismic intensity in degree (MSK-64).



FIG.II.1 - The seismological station of Tirana(TIR) (right) and Seismological Center (left).

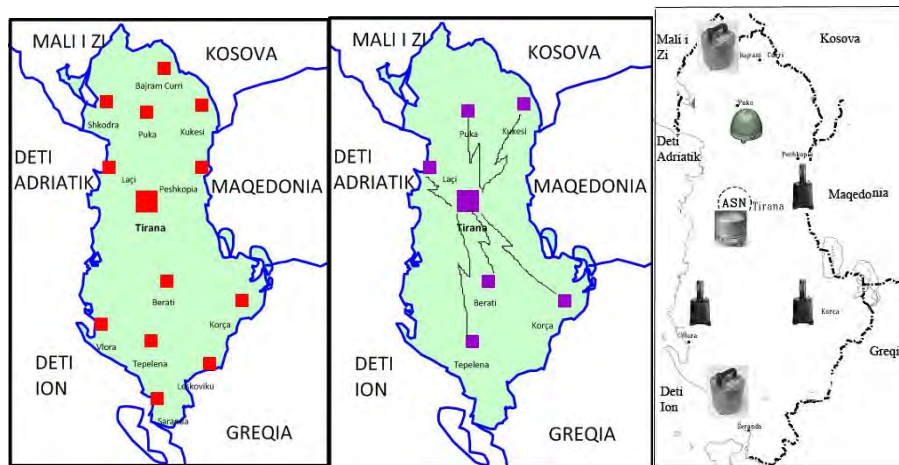


FIG.II.2 - Albanian Seismological Ndetwork (ASN) till the end of 1999 (left); the ASN stations with digital instruments GBV-316 (center) and the stations of ASN with satellite transmission (right).

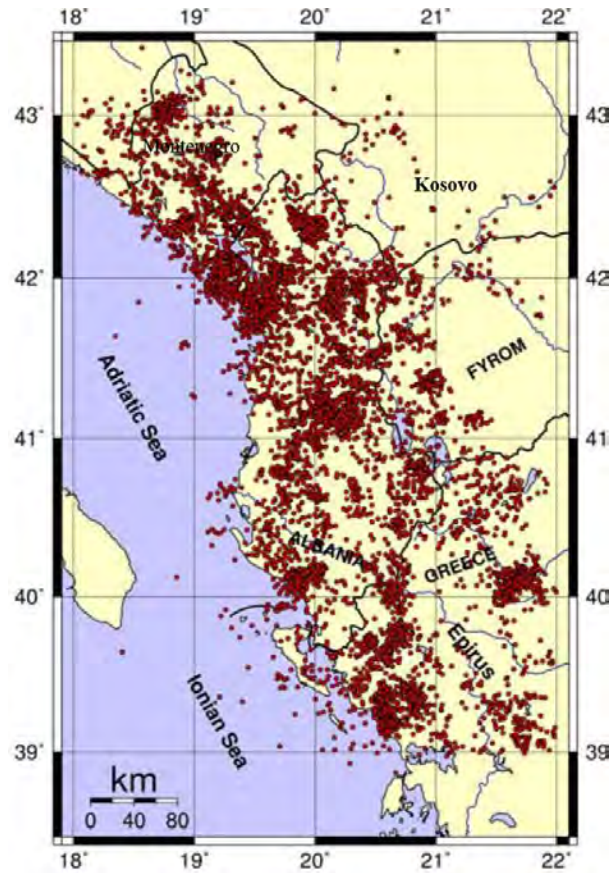


FIG.II.3 - The earthquakes of the catalogue of 1964-2000.

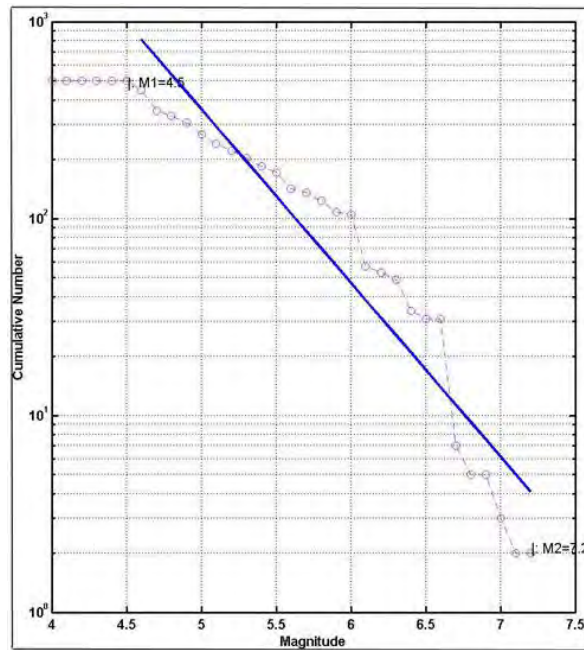


FIG.II.4 - Frequency-magnitude relationship for earthquakes of period 0-1995, $M \geq 4.5$.

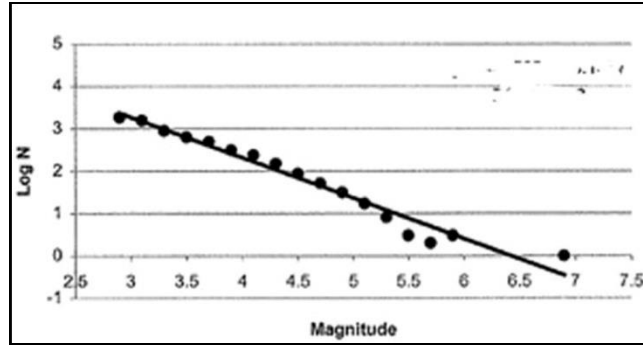


FIG.II.5 - b-value for Albanian earthquakes, 1964-2000 ($M_0=2.9$).

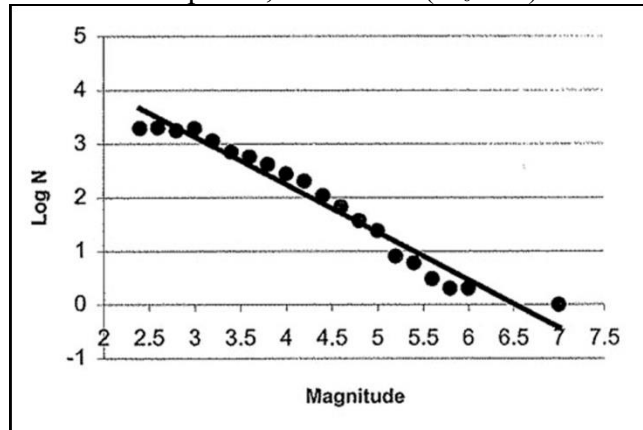
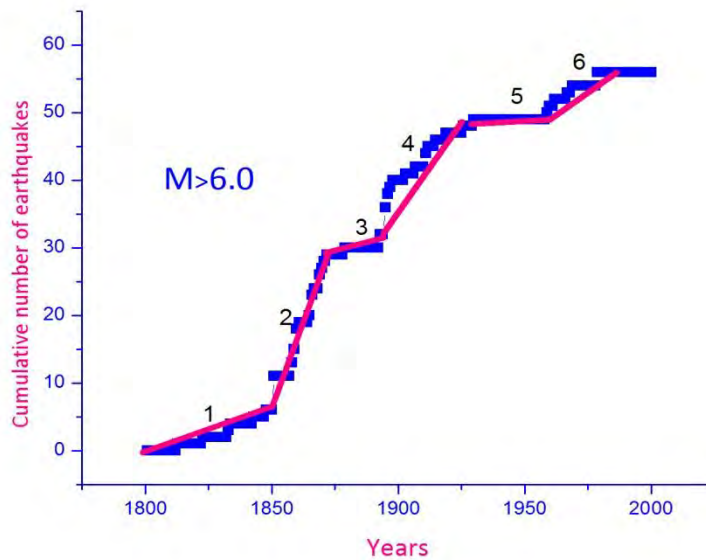
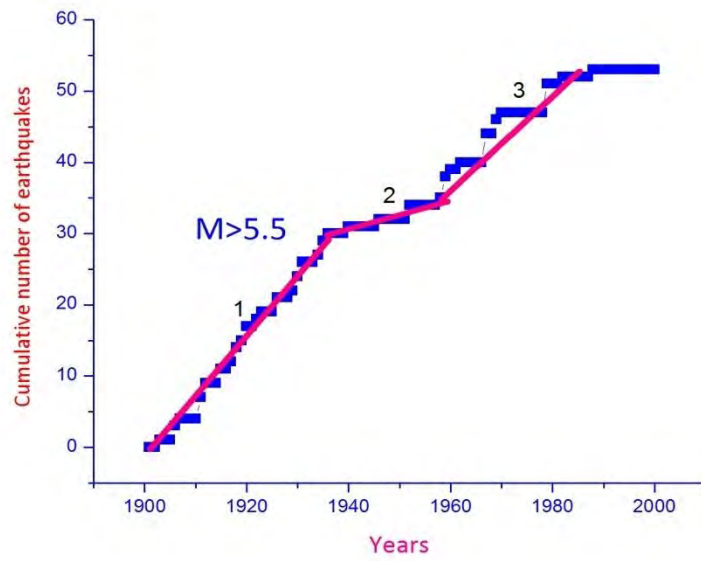


FIG.II.6 - b-value for Albanian earthquakes, 1964-2000 ($M_0=2.4$).



a)



b)

FIG.II.7 - The cumulative number of earthquakes during the time, a) $M > 6.0$; b) $M > 5.5$. Red lines and number indicate intervals with different seismic rates.

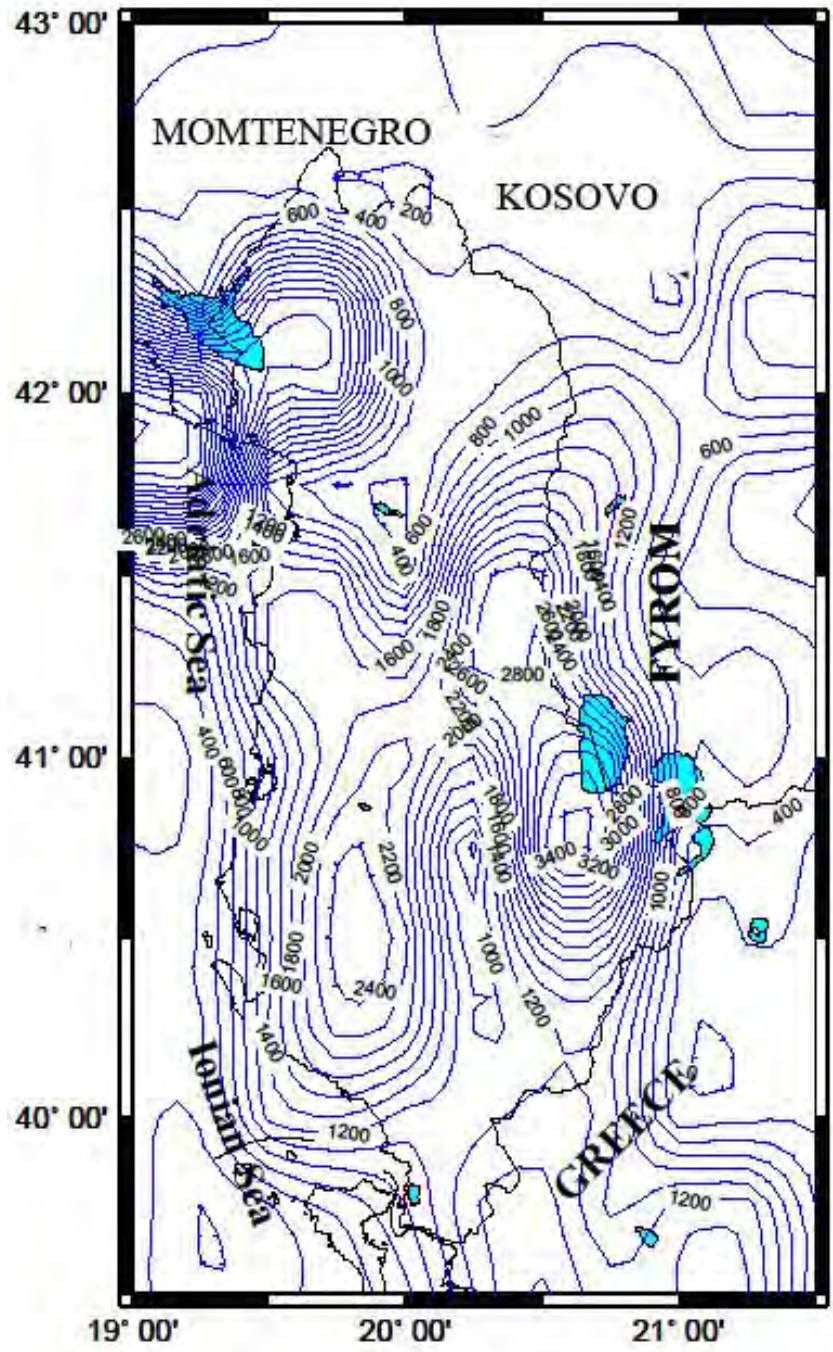


FIG.II.8 - Distribution of seismic energy released in Albania, 1901-1995.

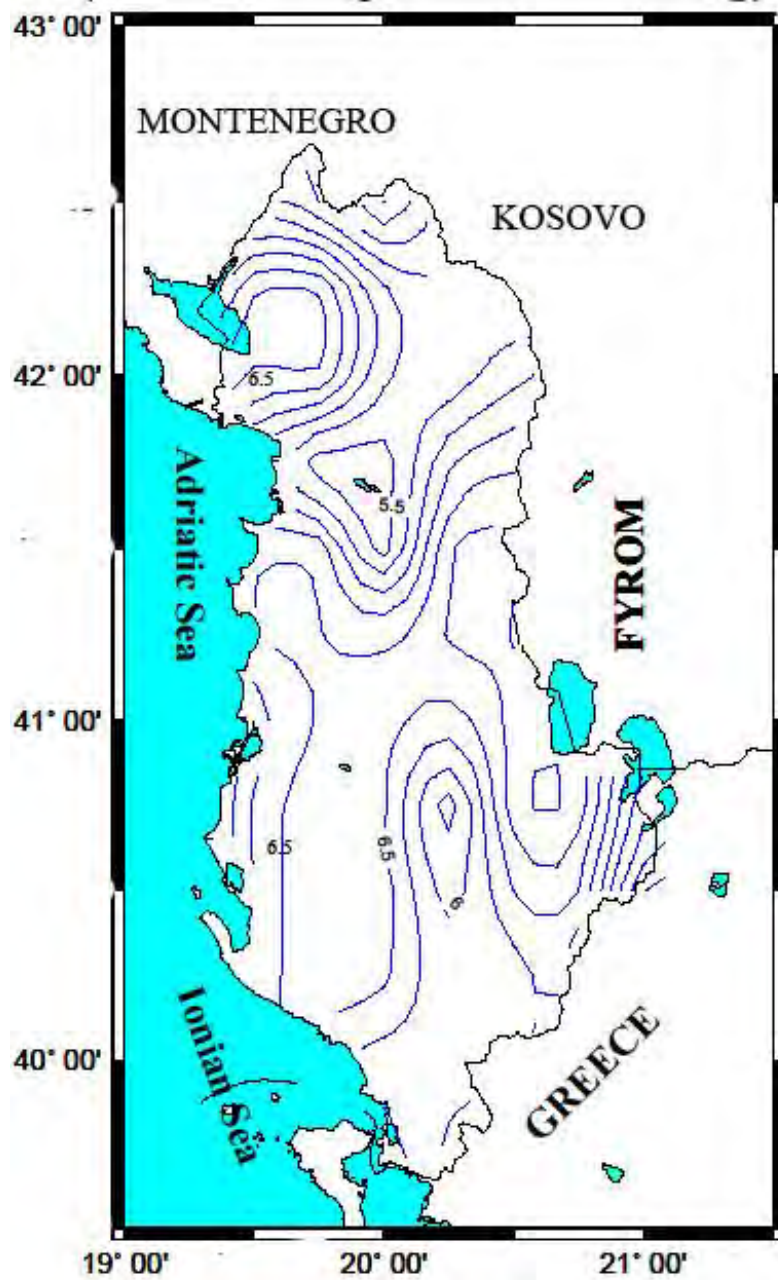


FIG.II.9 - Distribution of cumulative magnitudes for Albania, 1901-1995.

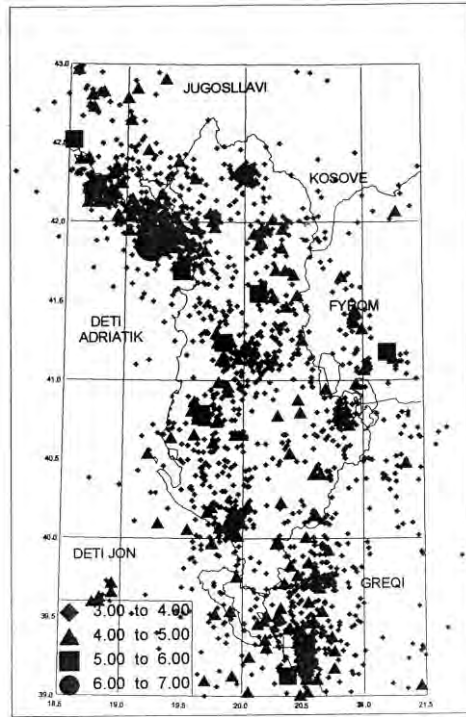


FIG.II.10 - Albanian earthquakes for the period 1976-1995.

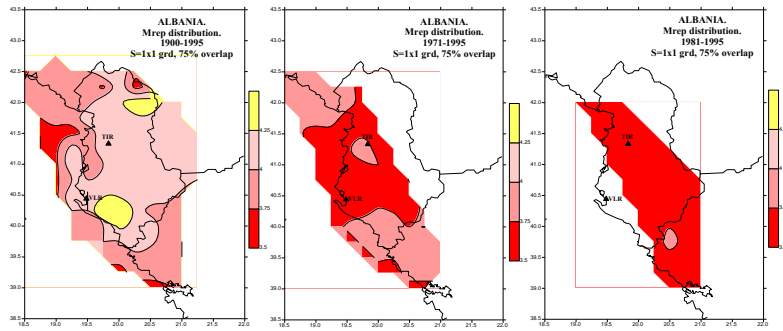
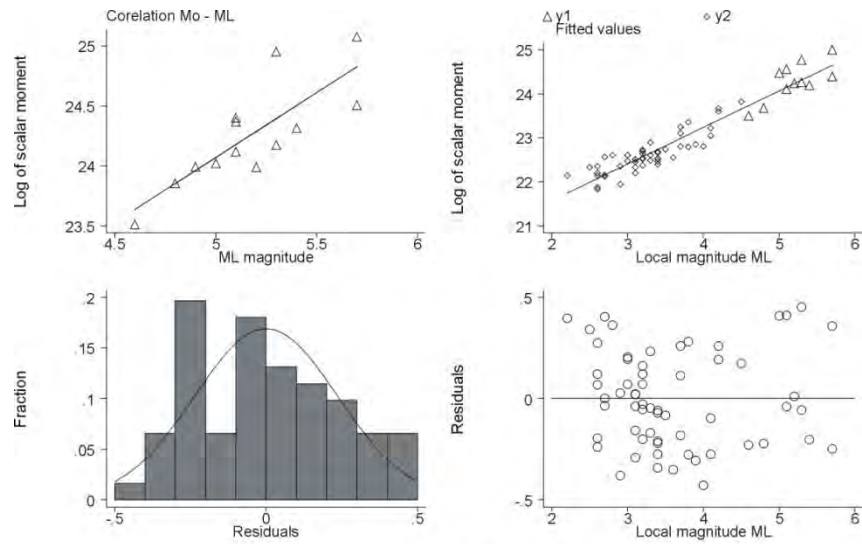
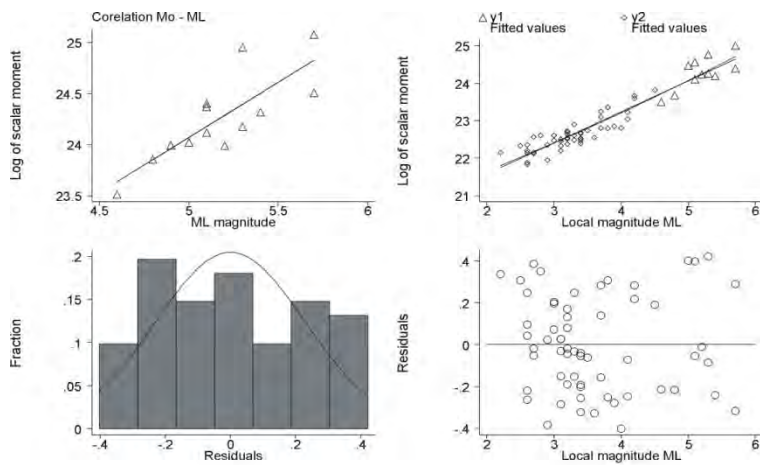


FIG.II.11 - M_{cut} for different observation period for Albania (Zavaylov, et al., 2002).



$$\text{Log}(M_o) = 0.832 \text{ ML} + 19.898$$

FIG.II.12 - The linear relation between the local magnitude and the moment magnitude.



$$\text{Log}(M_o) = 1 / (0.049 - 0.0015 \text{ ML})$$

FIG.II.13 - The non- linear relation between the local magnitude and the moment magnitude.

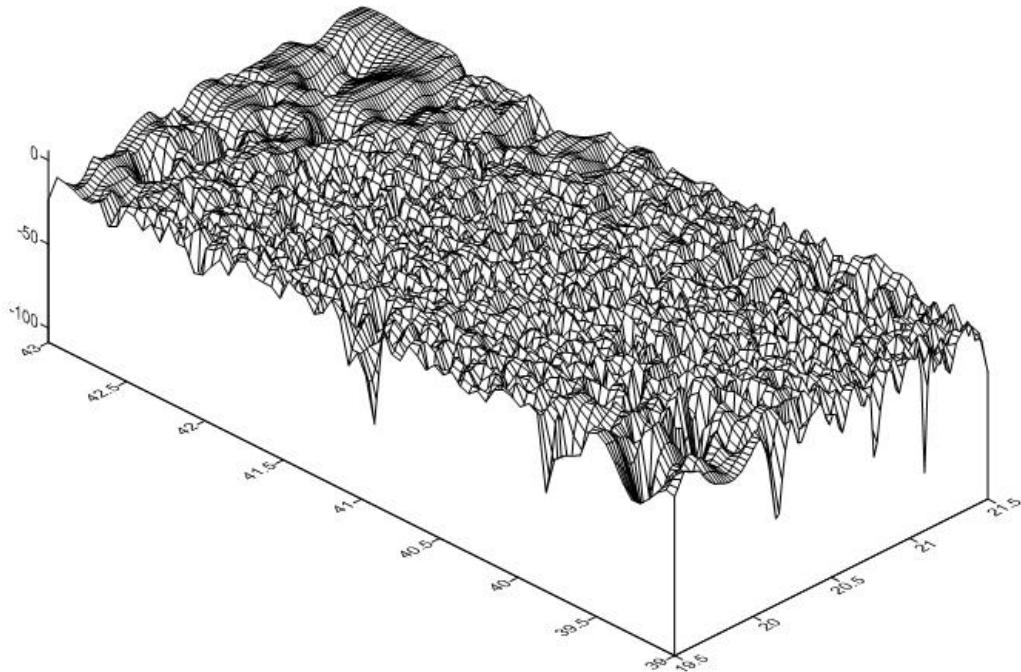


FIG.II.14 - Three dimensional view of hypocenters of Albanian earthquakes, 1964-2000.

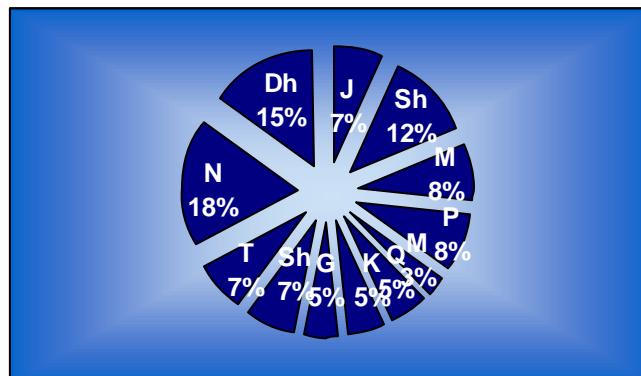


FIG. II.15 - The distribution of earthquakes of 1901-1990 according to the year's calendar.

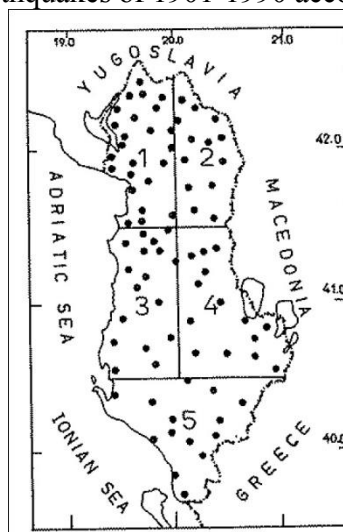


FIG.II.16 - The zones of the country where the cross-correlation between rainfall and seismic activity has been searched . Dots show the pluviometric station used for rainfall data.

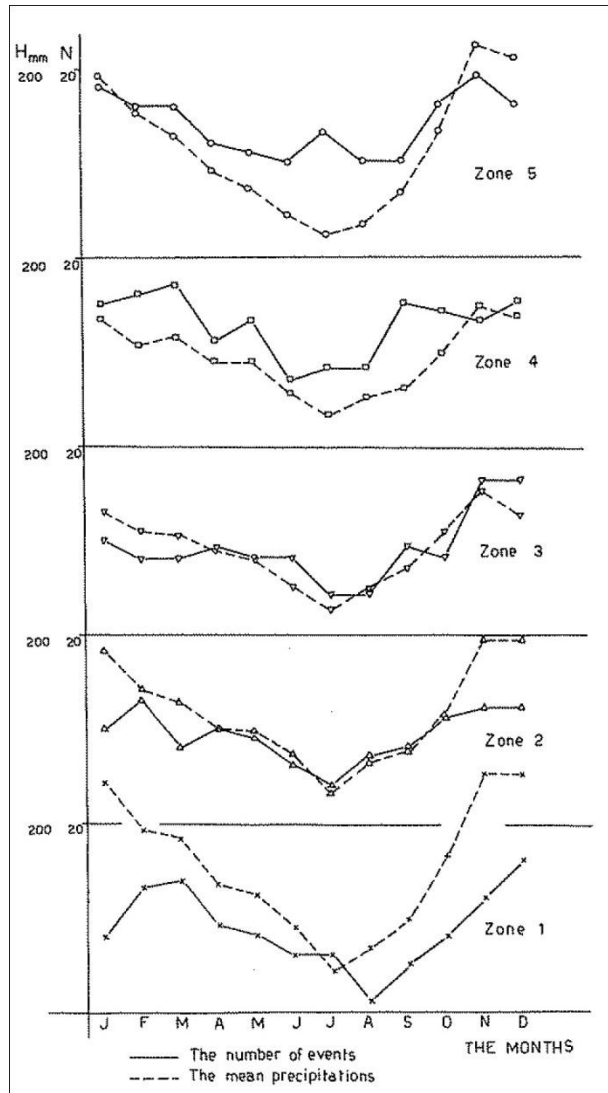


FIG.II.17 - Variation of seismic activity and rainfall for each zone generalized within 1 year.

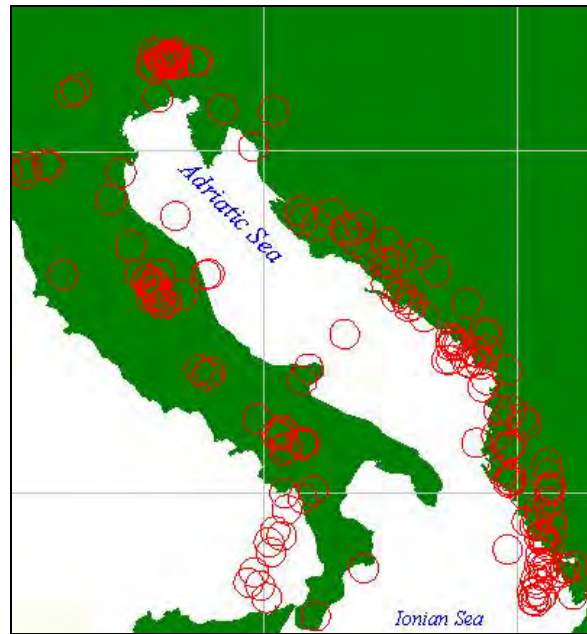


FIG.II.18 - Epicenters of earthquakes with $M > 5.5$ for the period 1501-2003, in the circium of Adriatic Sea.

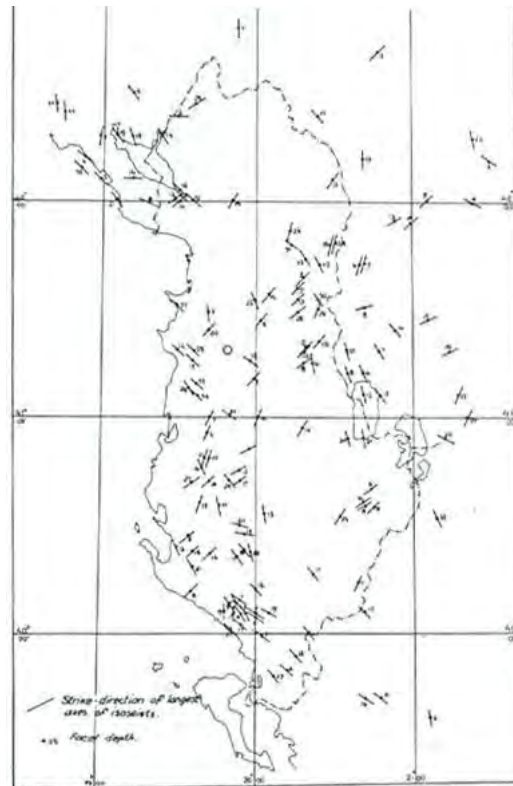


FIG.II.19 - Seismic fault and their type detected from fault plane solutions (Sulstarova, 1986,1988).



FIG.II.20 - The Longest Axes of the Iseismal Maps for 200 Earthquakes occurred in Albania and around for period 1800- 1988.

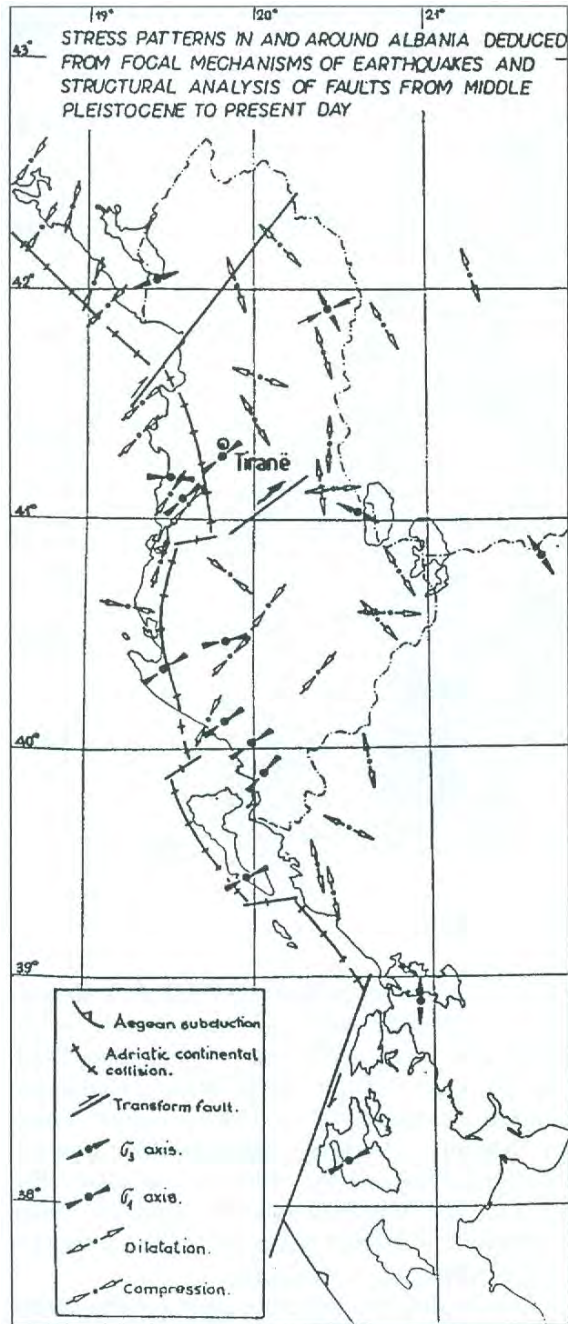


FIG.II.21 - Stress Patterns in and around Albania Deduced from Focal Mechanisms of Earthquakes.

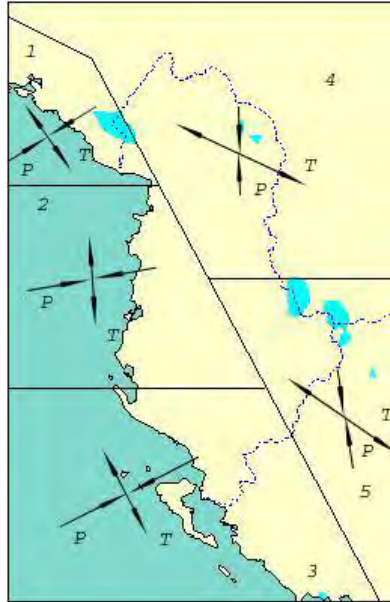


FIG.II.22 - Mean stresses obtained by Fisher analysis for 5 zones of Albania.



FIG.II.23 - CMT solutions for Albanian earthquakes, 1976-2000

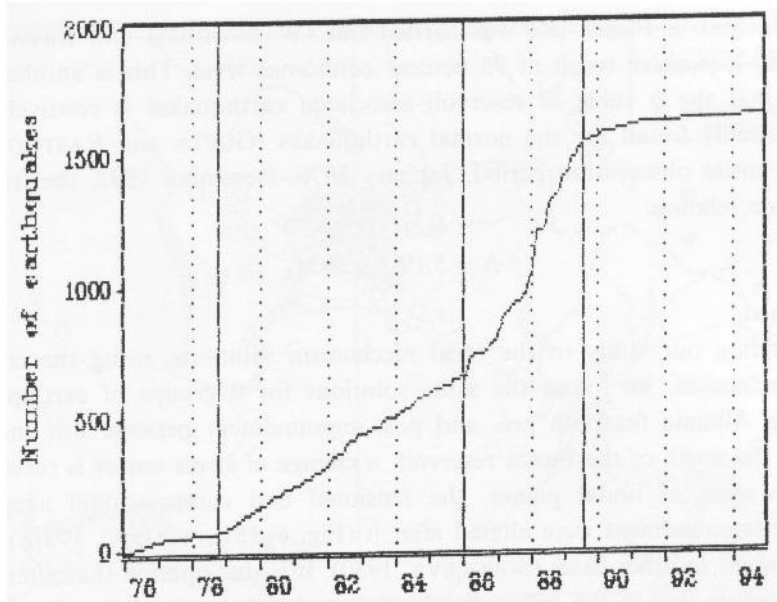


FIG.II.24 - Cumulative number of earthquakes near Lake of Fierza, 1976-1994. Solid vertical lines separate time intervals associated with different seismicity rates.

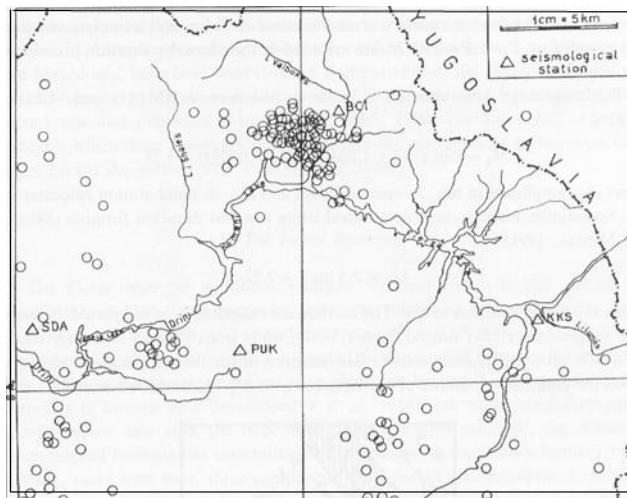


FIG.II.25 - The seismicity of Northern Albania ($M_L > 3.0$) from January 1976 to 1995.

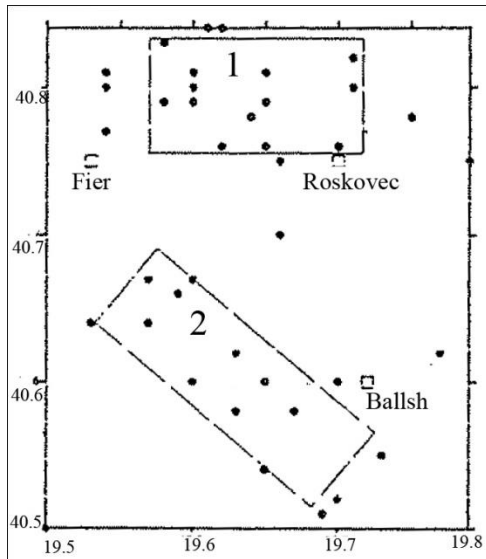


FIG. II.26 - Earthquake sequences: 1) March 2, 1976, Ballsh and 2) November 16, 1982, Roskovec (Muço, 1999).

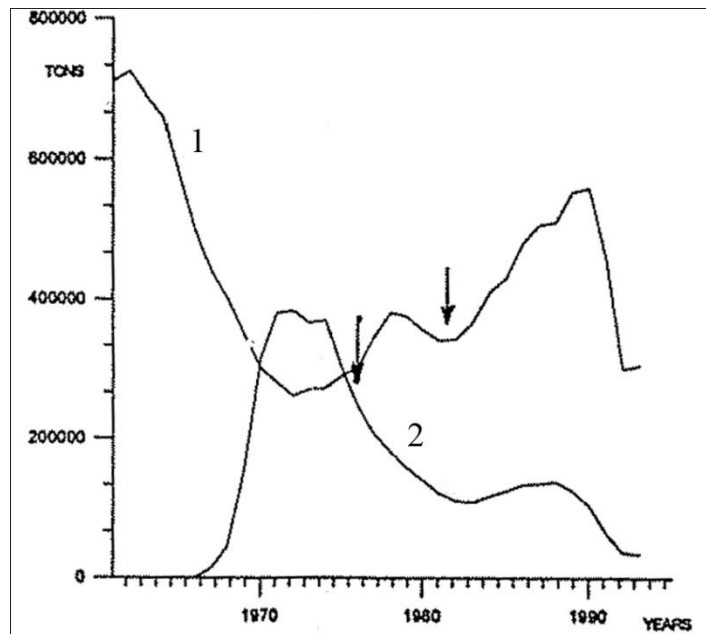


FIG.II.27 - Oil production in Marinza (1) and Ballsh (2). With arrows are noted time occurrence of abovementioned earthquakes (Muço, 1999).

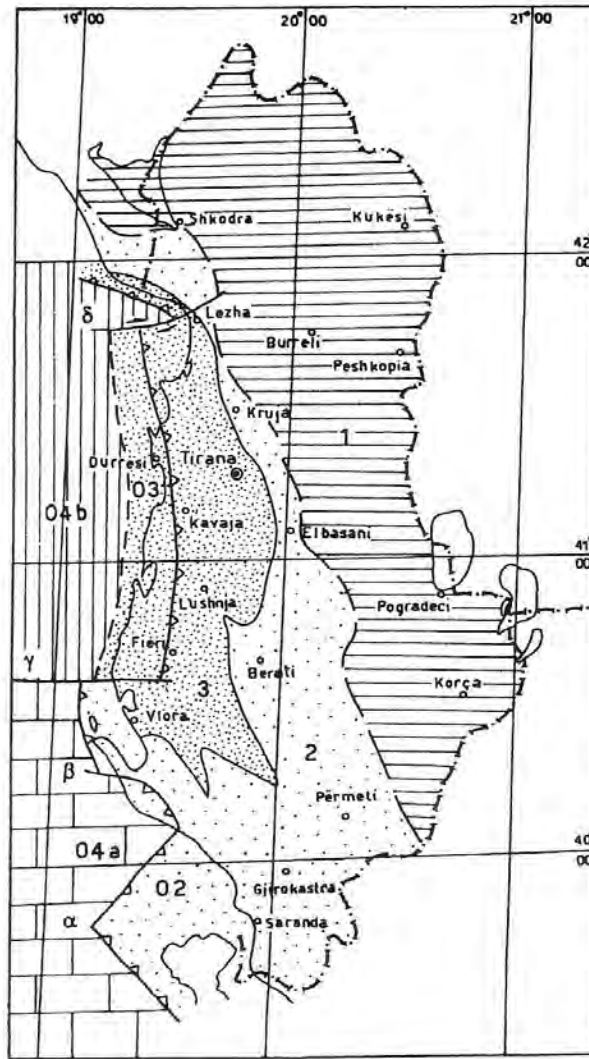


FIG.III.1 - Map of neotectonic zonation of Albania (Aliaj, 1998).

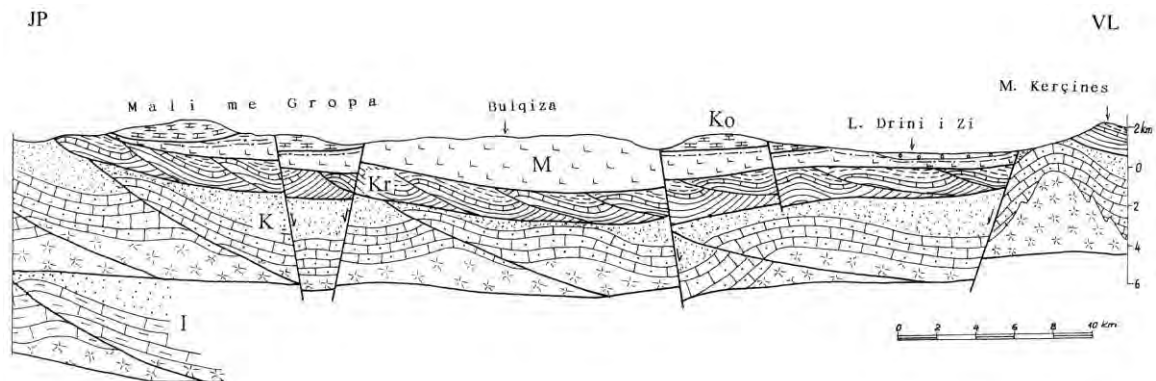


FIG.III.2 - Geological profile of Mali me Gropa - Mali i Kërçinës (Aliaj and Meço, 1994).

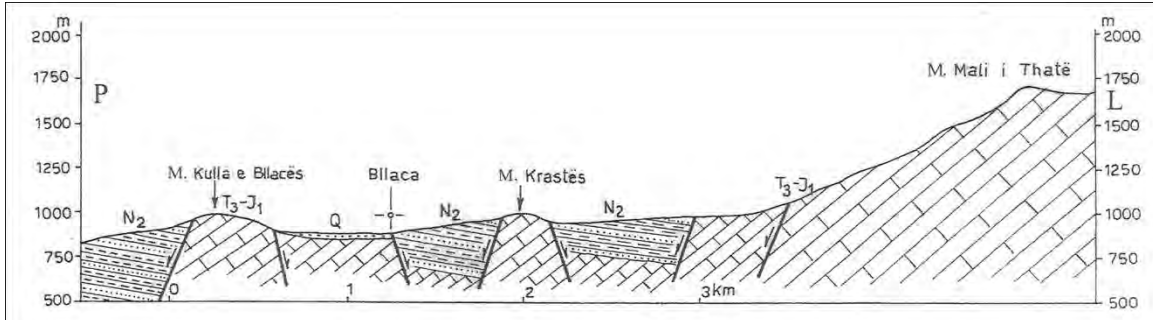


FIG.III.3 - Geological profile south of Pogradeci (Aliaj, 2006).

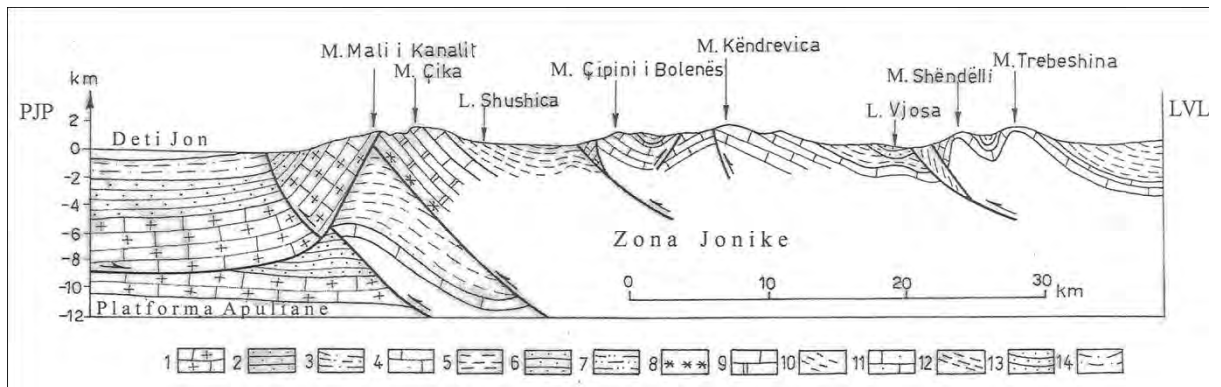


FIG.III.4 -Geological profile Mali i Kanalit – Mali i Trebeshinës: Treangle zone on the overthrust front of orogene (Aliaj, 2006).

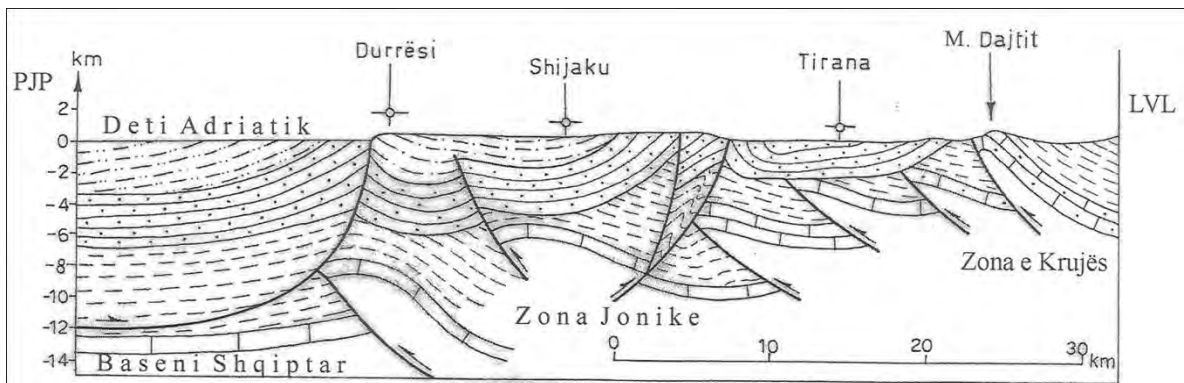


FIG.III.5 - Geological profile Adriatik Sea– Dajti Mountain. (Aliaj, 2006).

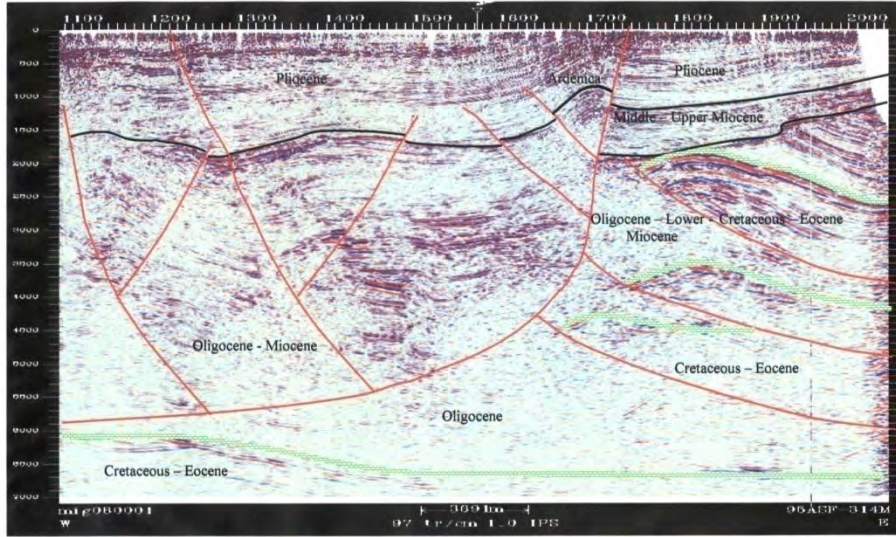


FIG.III.6 – Seismic profile: Seman (Aliaj, 2006).

PJP

LVL

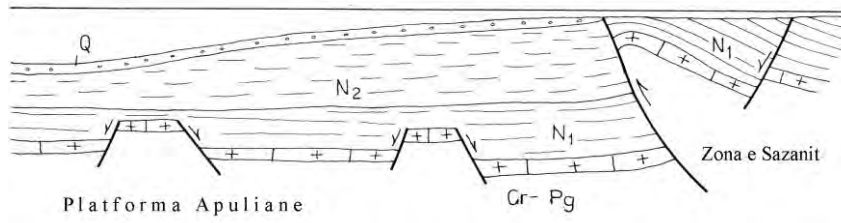


FIG.III.7 –Geological profile on south of Sazani Island. (Aliaj, 1998).

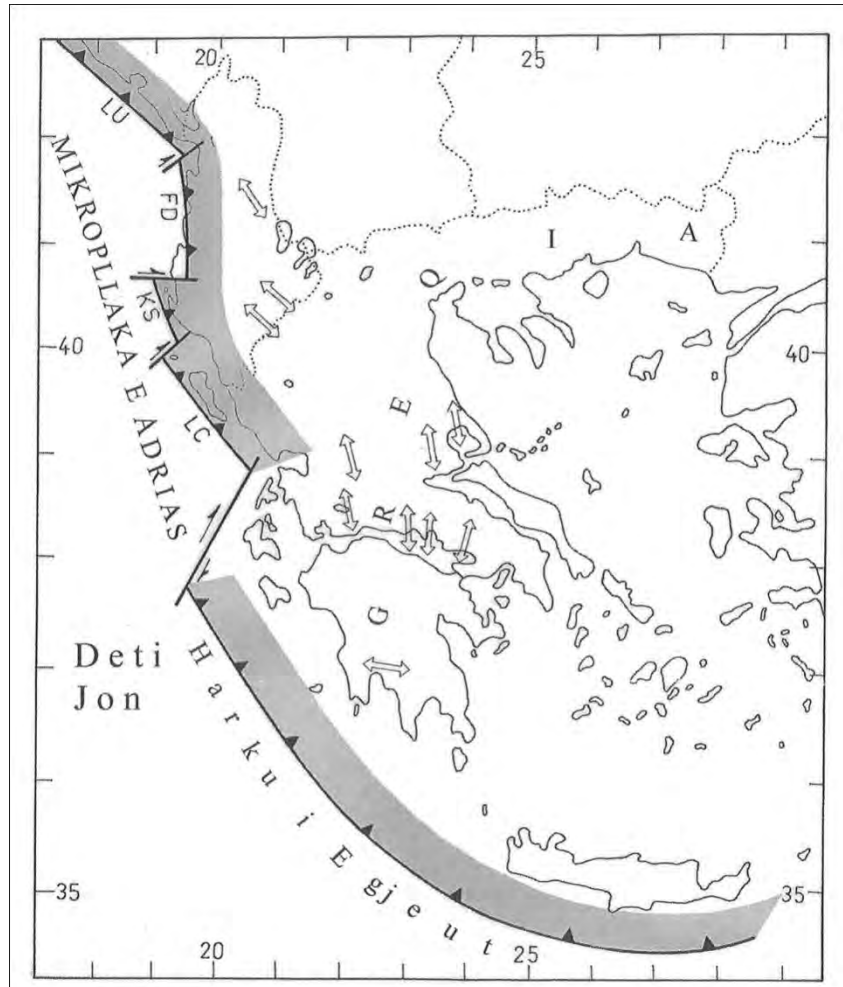


FIG. III.8: The southern edge of Euroasiatic plate. Adriatic collision and Aegean Ark (Aliaj, 2006).

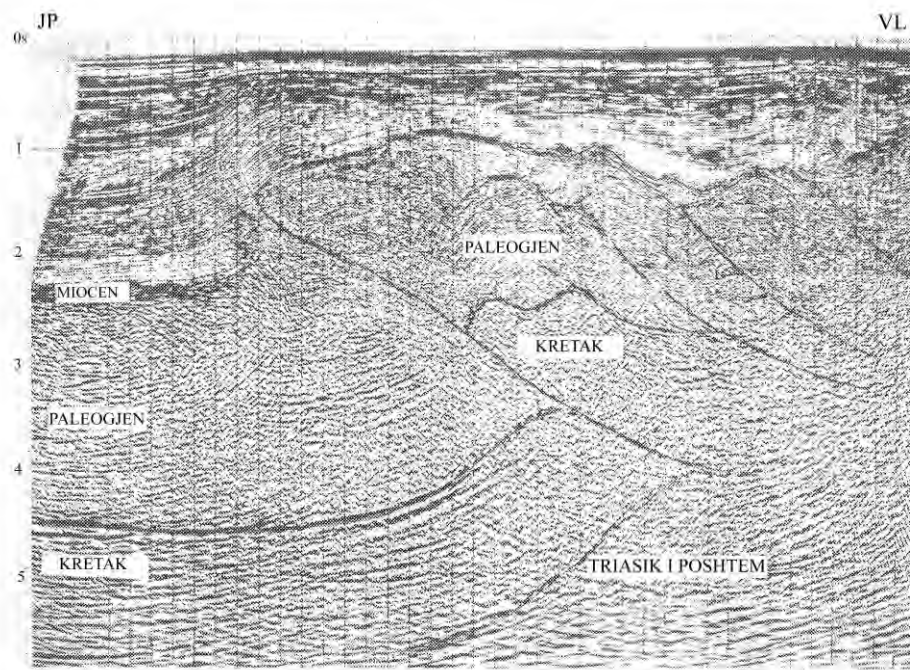


FIG.III.9 – Seismic profile at Kotorri. (Dragasevic, 1983)

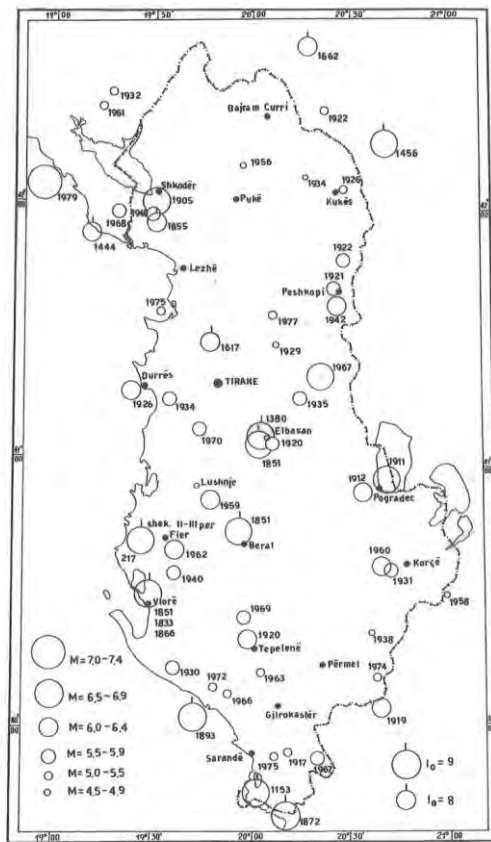


FIG.III.10 – Map of epicentres of characteristic earthquakes from the energy point of view for every fault zone and separate fault. (Aliaj, 1979)

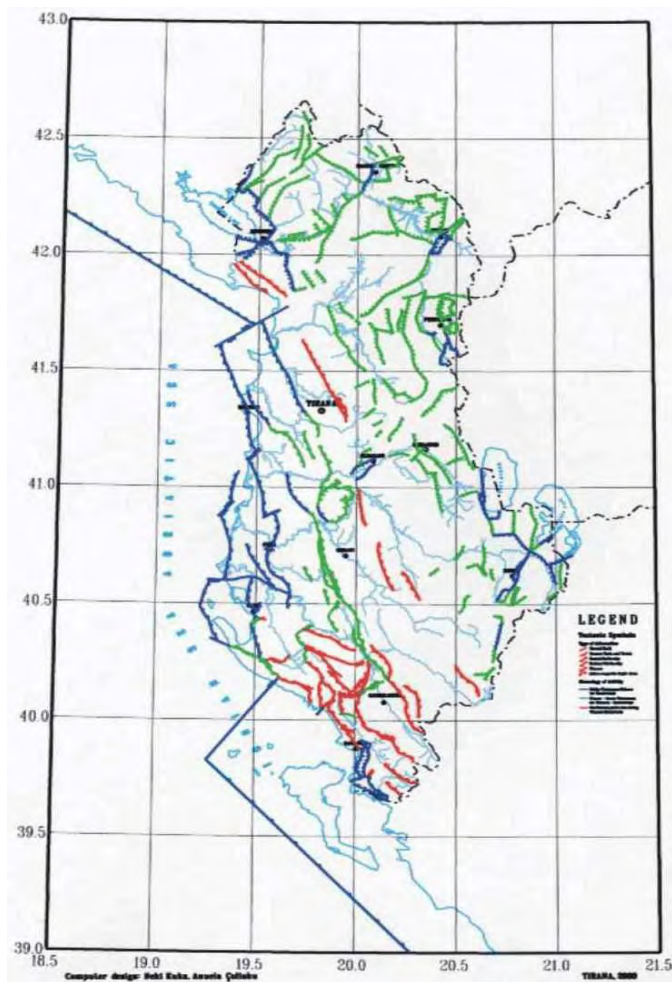


FIG.III.11 – Map of active faults in Albania (Aliaj, 2000b).

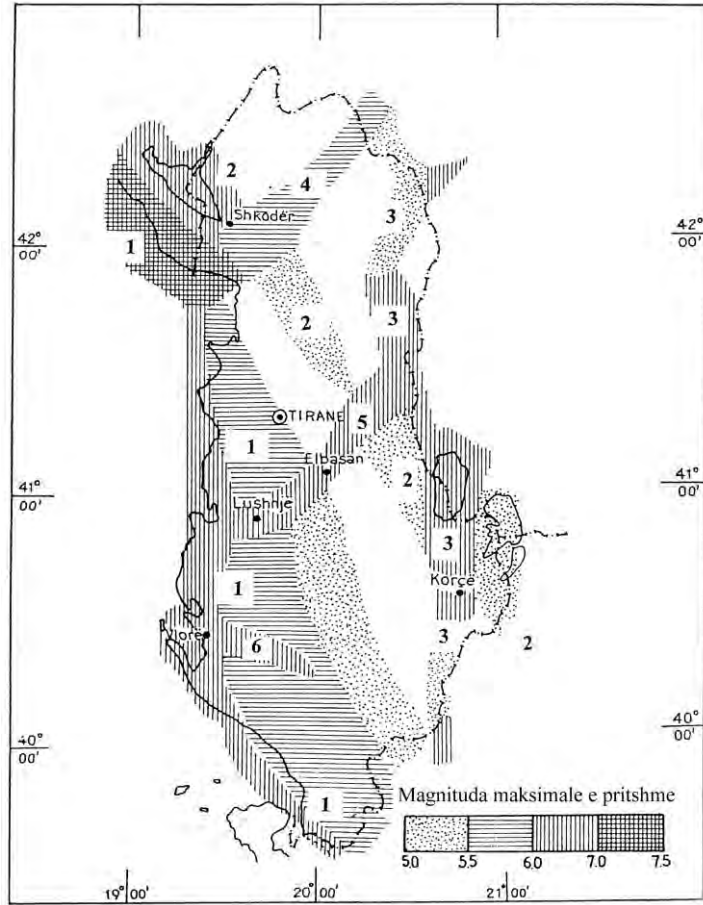


FIG. III.12: Map of seismoactive zones in Albania with maximum expected magnitude. (Aliaj, 1988a).

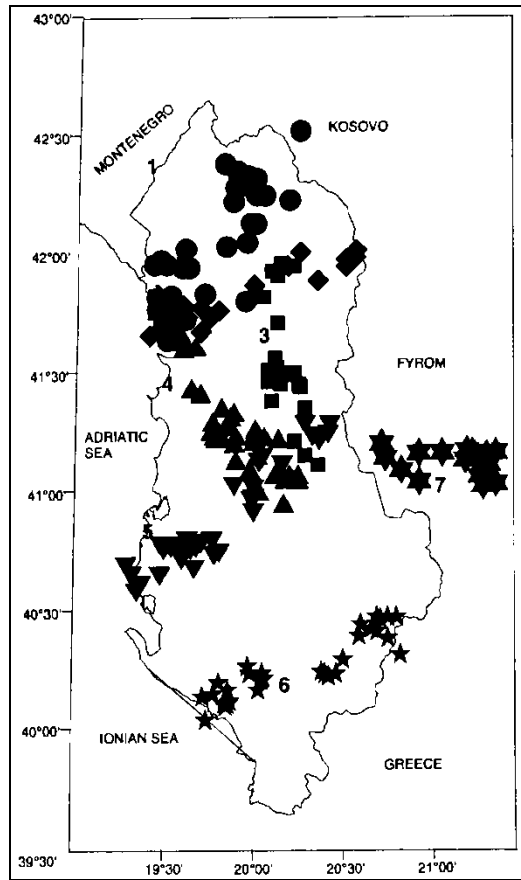


FIG.III.13 - Fault Detection by Lineaments of Consecutive Epicenters.

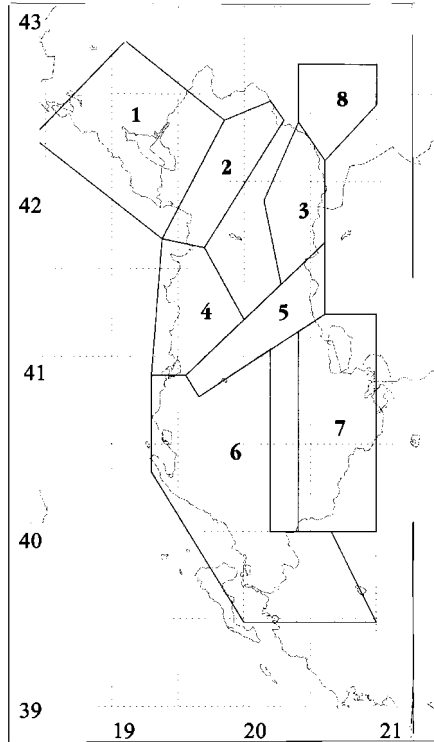


FIG.I.2 - Seismogenic zones used for deterministic seismic hazard assessment of Albania.

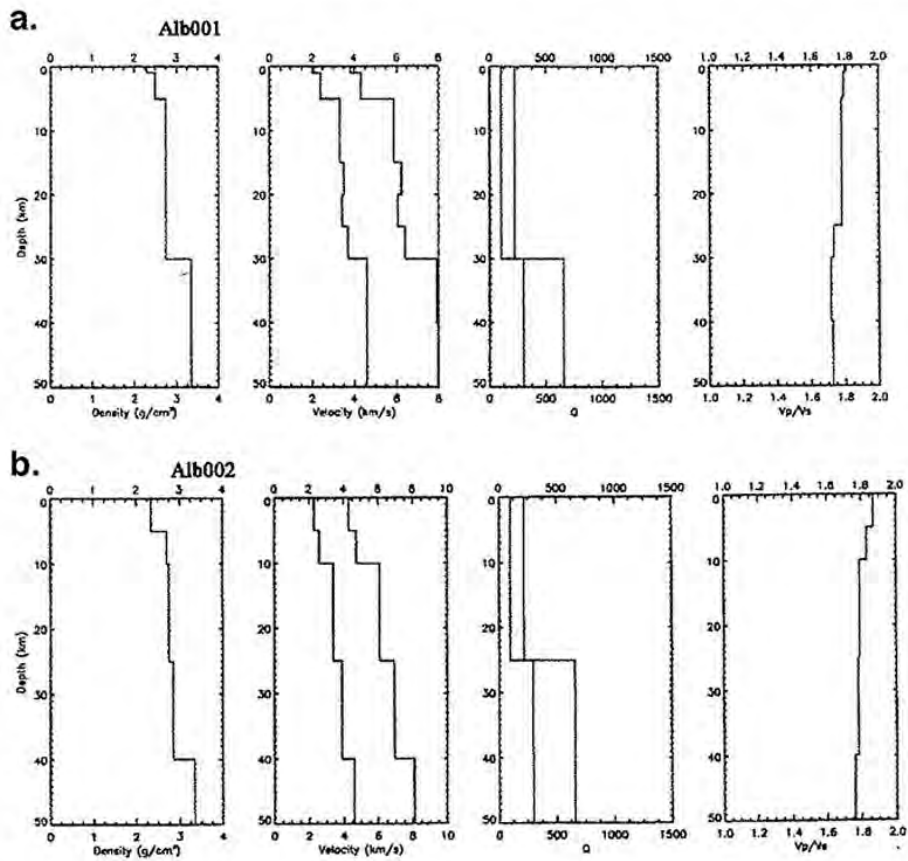


FIG. I.3 - The velocity submodels used for a) outer zone of Albania and b) for inner zone of Albania

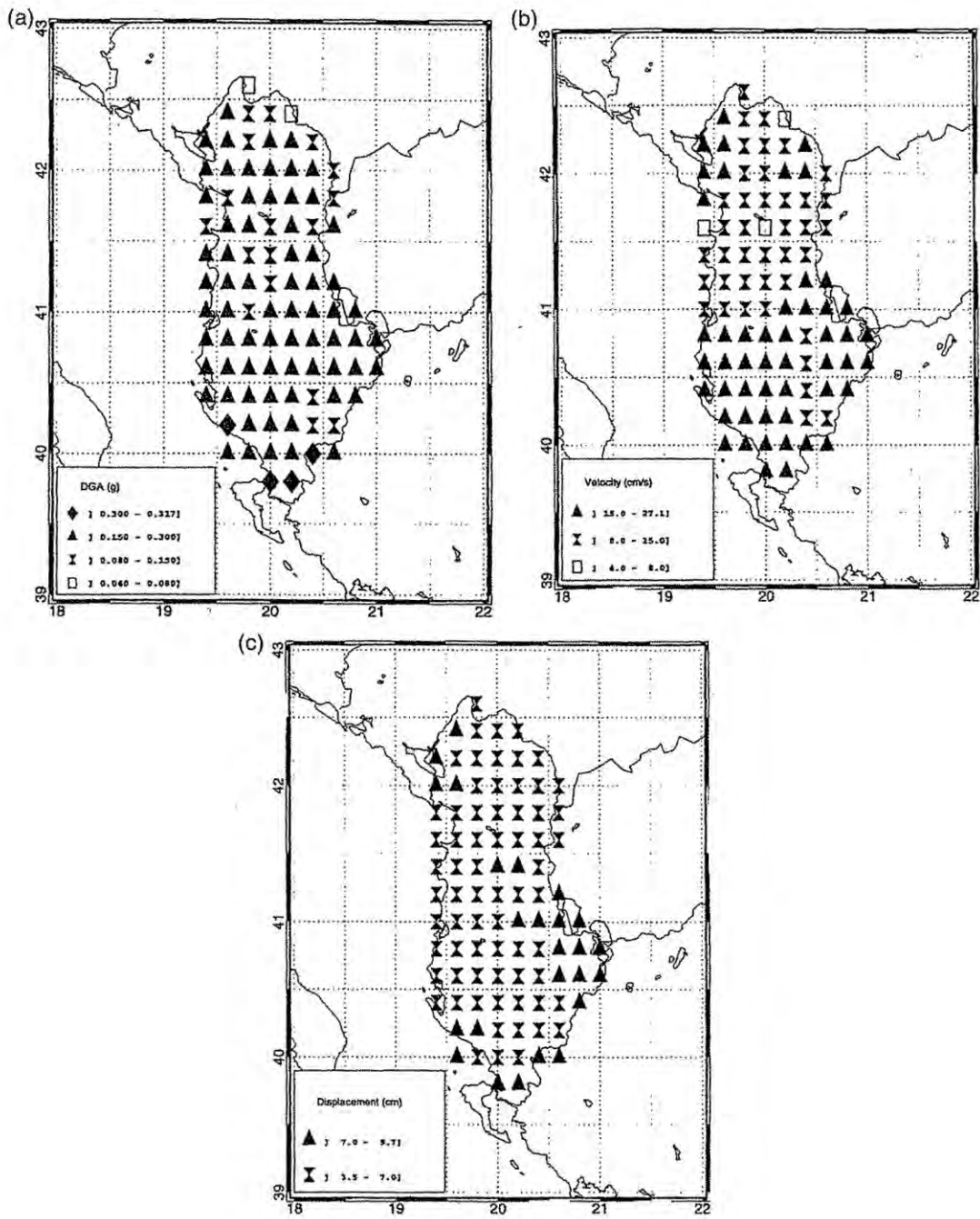


FIG.I.4 - The ground motion parameters obtained: a) DGA, b) velocity and c) displacement.

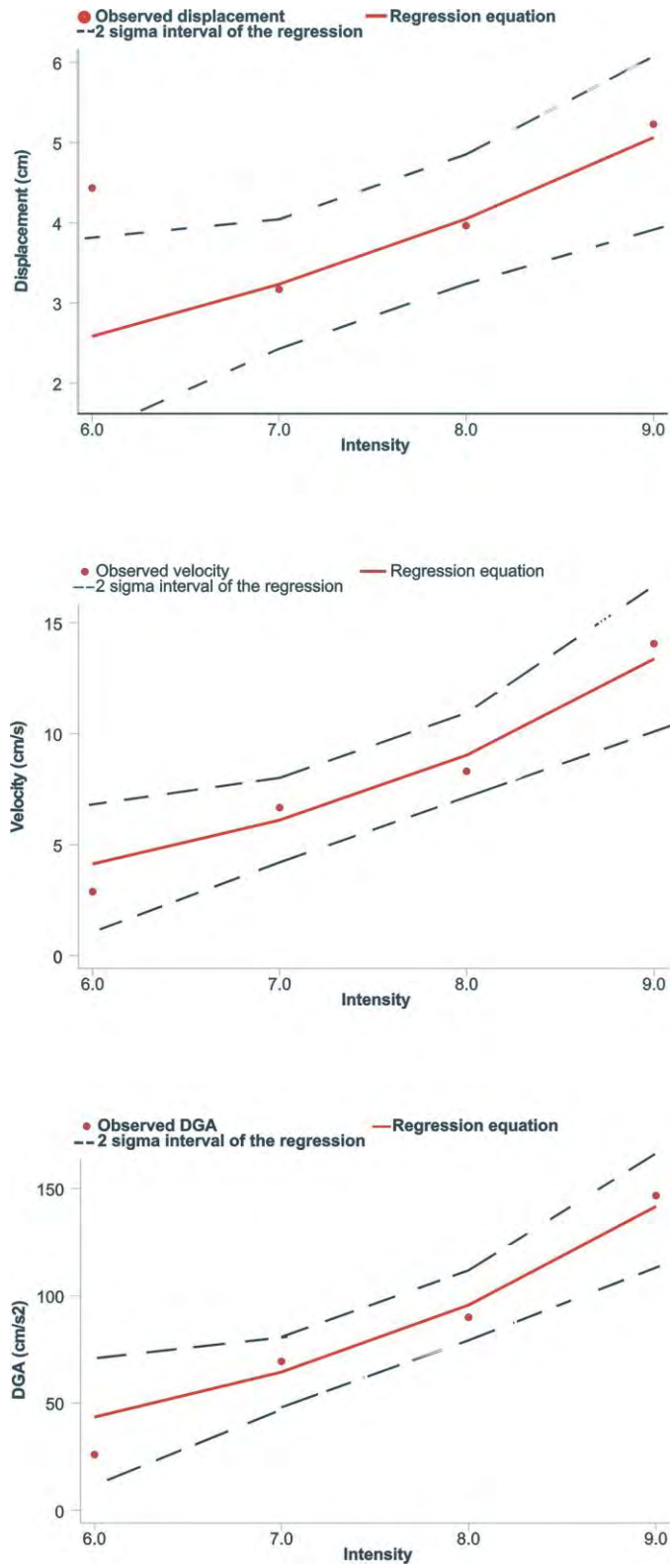


FIG.I.5 - The relations between observed intensities and parameters of ground motion.

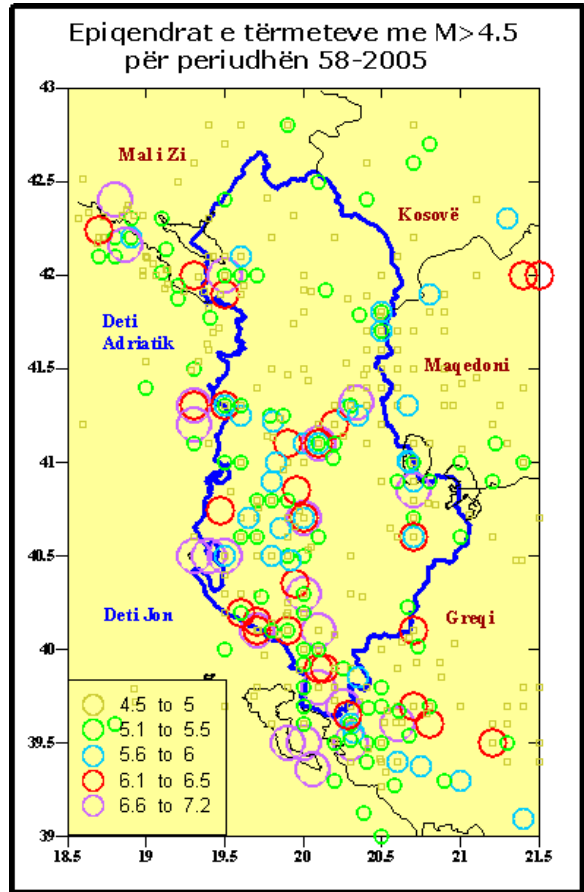


FIG.II.1 - Map of earthquake epicenters of Albania with $M_s \geq 4.5$ for the period 58-2005, used for seismic hazard assessment of our country (Sulstarova et al., 2005a).

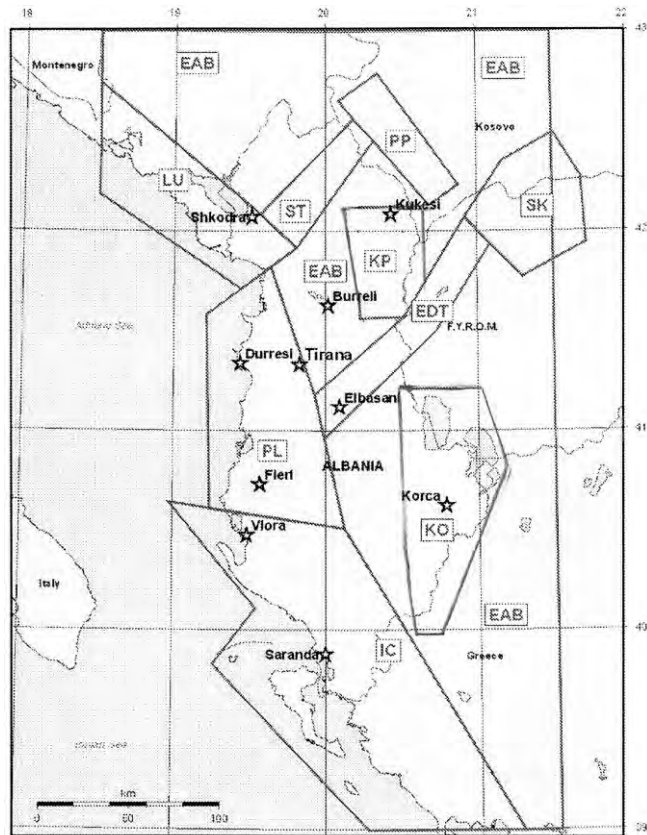


FIG.II. 2 - Map of seismic source zones in Albania (Sulstarova et al., 2005b).

