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ULF electromagnetic variations connected with a seismic center

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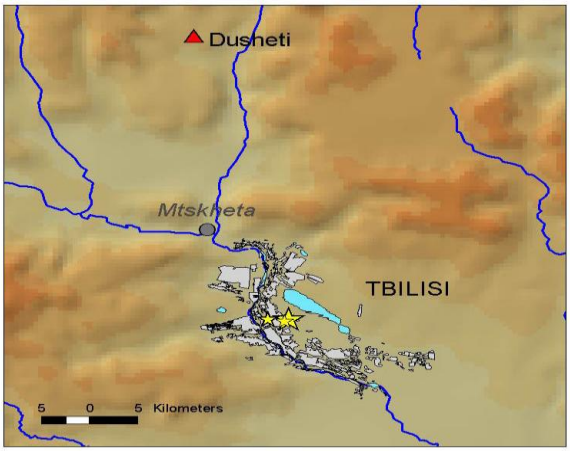
Abstract

1. Introduction

At present investigation of low-frequency radiation (ULF) of electromagnetic fields in a range of frequencies 10-0,001 Hz having lithosphere origin has an actual meaning as there is an assumption, that with their help it is possible to trace processes taking place in earthquake preparation. In works [1-5] ULF radiations before strong earthquakes (M≥4) and during time aftershock activity in different regions of globe were investigated by authors, therefore it was revealed, that before activation of tectonic processes the increase in amplitude ULF since several hours about several days before earthquake is observed. However ULF is possible to register in close epicenter zones in radius ≈120-150 km. The above-stated frequency range of electromagnetic radiations are a consequence of two processes - ULF from area of active tectonic movements of change of geoelectric conductivity inside and nearby the centre of earthquakes that leads to occurrence on a terrestrial surface of the electromagnetic waves reflected from lithosphere of anomaly [6-9].

2. Equipment



To carry out experimental works Device MVC-3DS designed by SpbF IZMIRAN was applied. This device has possibility to register in a continuous mode three magnetic components H, D, Z, three electric E_x, E_y, E_z, and three seismic channels. It has GPS and 24-bit ADC. A frequency range of measurement is 0-10Hz, a dynamic range for magnetic component H, D, Z ±500 NT, for electric ±2500 mV, for seismic ±2500 mV. The obtained data are registered on PC. Fig.1 shows the chart where places of carrying out of experimental works (Observatory Dusheti) and epicenter region (Tbilisi).

3. Experiment

Measurements of an electromagnetic field in Georgia were spent in Dusheti with geographical co-ordinates φ = 42°05′19 ″ N and λ = 44°41′43 ″ E. In device MVS-3DS six channels were used, three magnetic H, D, Z, two electromagnetic E_x, E_y, and instead of E_z were switched on one seismic channel S_z. Frequency of measurement was 5 Hz, base for electrodes was ≈25 m.

Due to the technical reasons observation has begun by the end of March, 2002 and it lasted till April, 2003. During this period investigated region did not show tectonic activity, basically earthquakes with magnitude Ms ≤ 2,5 took place, and stronger earthquakes took place far from observation point (Δ> 200 km).

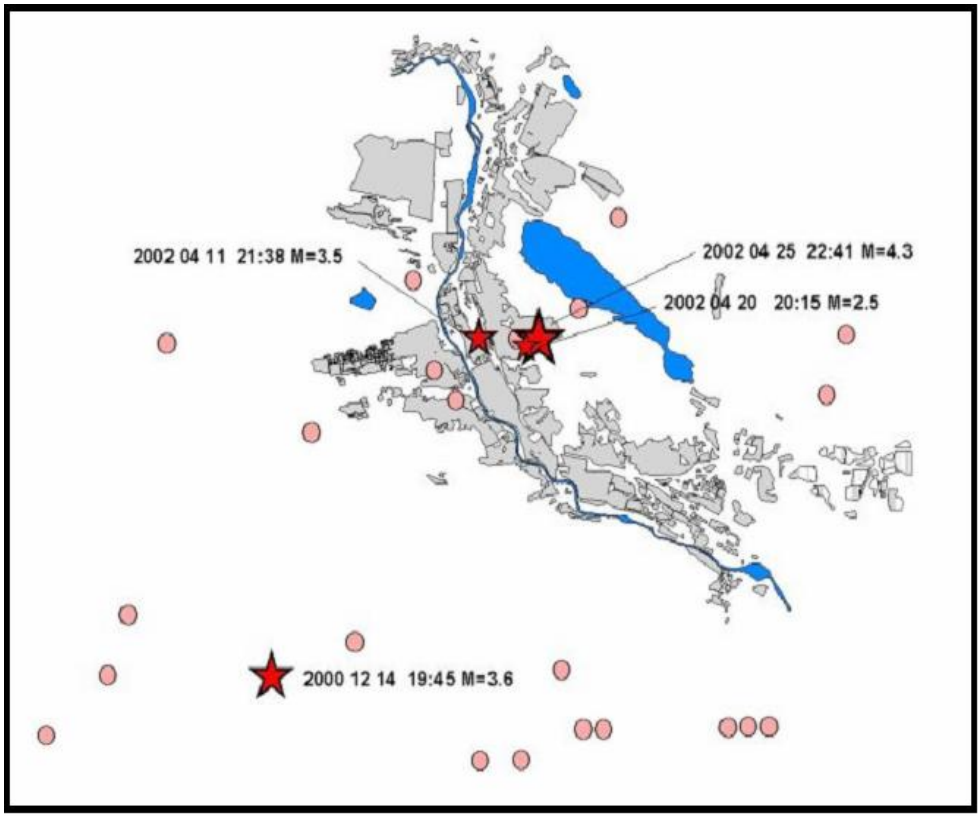


Fig. 2

Rather not the big increase of seismic activity was observed in April, 2002 in Tbilisi. On the Fig. 2 geographical position of observational point for shocks and main push M=4.2 (big asterisk) which has occurred 25.04.02, 22^h 15^m LT is shown. Distance between point of observation "Dusheti" and epicenter zones is ≈42 km. Earthquakes occurred on a historical break where and earlier was observed tectonic activity. On our representations epicenter of area of earthquake has the form of narrowly extended arch located along a line of assumed rupture of earth crust, passing on the bent axial line of the Tbilisi water basin. This tectonic element most likely merges with the so-called Zemo-Avchala disposition shown in Neocene formations in north-west direction of an extremity of the Tbilisi water basin. On this miscellaneous of adjournment Miocene adjoins with top Oligocene.

4. Results

Results of processing of experimental data are resulted on Fig. 3a and 3b.

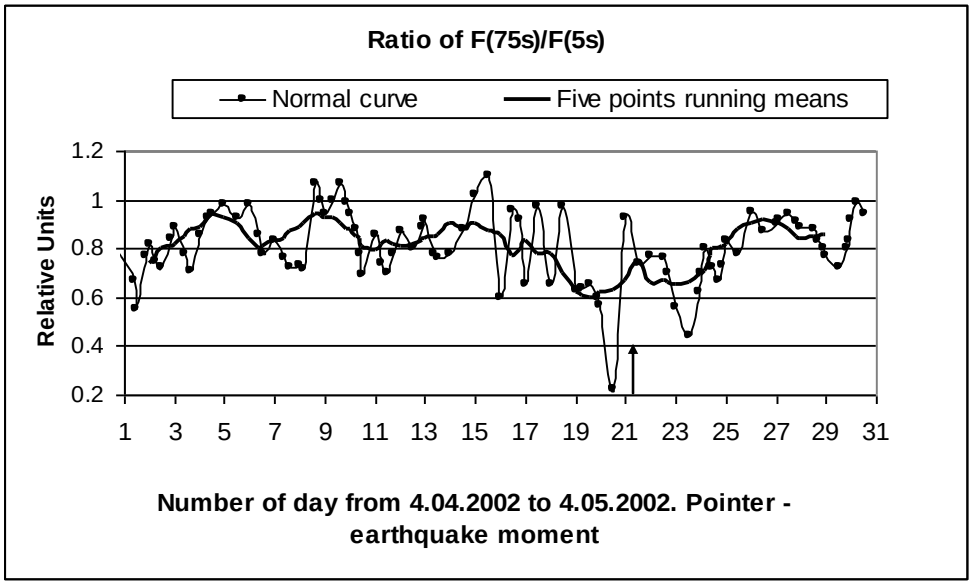


Fig. 3a

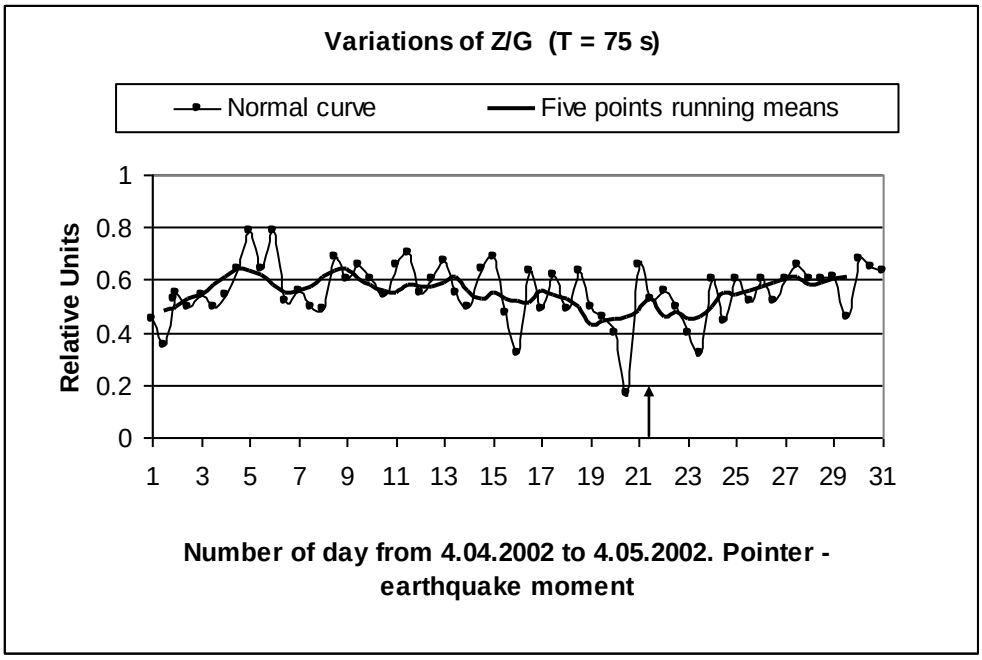


Fig. 3b

On the Fig. 3a a picture schedules of parameter F (75s)/F(5s), where F=Z/G, and G = $(X^2+Y^2)^{1/2}$ in the range of time of 0,3-0,5 hours of local time are resulted. The thin diagram with the point represents behavior of this parameter before earthquake and the bold diagram is the same parameter, only it is constructed by a method of an average showing for five points. On the Fig. 3a a picture schedules of parameter Z/G for period of T=75 second.

On schedules it is accurately expressed, that before the main push decrease in parameters F (75s)/F(5s) and Z/G is observed. After earthquake both parameter are restored and reach level at a quiet tectonic field. This effect specifies that before earthquakes in central zone becomes more active ULF radiation in a wide frequency range. Monitoring of ULF radiation can trace behavior of this field before activation of tectonic processes that in a consequence will help to track activation of tectonic processes.

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Fig. 3.

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УНЧ электромагнитные вариации, связанные с очагом землетрясения

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Резюме

С помощью магнитовариационной станции MVC-3DS одновременно регистрировались вариации электромагнитного поля литосферного происхождения в диапазоне частот 10 - 0.001 гц и сейсмические колебания. Анализ результатов показал, что за несколько часов до Тбилисского землетрясения наблюдалось аномальное увеличение амплитуды УНЧ колебаний в широком диапазоне частот. После землетрясения параметры восстанавливаются и достигают уровня спокойного тектонического поля.

მიწისძვრის კერასთან დაკავშირებული უდს ელექტრომაგნიტური ვარიაციები

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რეზიუმე

MVC-3DS ტიპის მაგნიტოვარიაციული სადგურის მეშვეობით ხდებოდა 10 – 0,001 ჰც სიხშირის ლიტოსფერული წარმოშობის ელექტრომაგნიტური ველის ვარიაციების და სეისმური რხევების ერთდროული რეგისტრაცია. მიღებული შედეგების ანალიზმა აჩვენა, რომ თბილისის მიწისძვრამდე რამდენიმე საათით ადრე სიხშირეების ფართო დიაპაზონში დაიკვირვებოდა უდს რხევების ამპლიტუდის ანომალური ზრდა. მიწისძვრის შემდეგ ხდება ამ პარამეტრების აღდგენა და ისენი უბრუნდებიან წყნარი ტექტონური ველის დონეს.