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**EARTHQUAKES PREDICTION:
DISCOVERY OF THE NEW REGULARITY OF SEISMIC NOISE BEHAVIOR.**

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SUMMARY. The discovery of the previously unknown regularity of seismic noise (weak high-frequency Earth microseisms) emissions with unique characteristics during the earthquakes preparation period which led to new understanding of the physics of the source of earthquakes, the forms of energy propagation and transformation from the source, the processes which take place in the lithosphere, has shown the non-linear character of the microseisms propagation and interaction with the medium. The reliable seismic precursor has been revealed. Have studied its amplitude, frequency and timing manifestations in period prior to earthquakes and worked out criteria of seismic system to predict earthquakes on the bases of discovered precursor.

INTRODUCTION. Our view of the causes of, and approach to solving the earthquake prediction problem and necessity of the special seismological and geophysical system creation are based on discovery of the previously unknown regularity of seismic noise (weak high-frequency Earth microseisms) emissions with unique characteristics during the earthquakes preparation period.

This led to new understanding of the physics of the source of earthquakes, the forms of energy propagation and transformation from the source, the processes which take place in the lithosphere, has shown the non-linear character of the microseisms propagation and interaction with the medium.

The new regularity was recognized in March 1988 as a scientific discovery by the former USSR State Committee on Inventions and Discoveries with priority from May 1979.

The formula of the discovery is stipulated as follows: “Previously unknown regularity of changes in microseisms before an earthquake has been established, which stipulated at the distance that exceed the size of the epicenter zone there are being registered a multi-stage increasing in the intensity of microseisms with simultaneous decreasing of their main frequency and there arise recurring impulses (zugs) of micro-oscillations that are increasing in intensity and decreasing in time between their appearances, which are polarized in the direction of the epicenter of the future earthquake”.

The research on microseisms anomalies as a tool for prediction of earthquakes based on the analysis of the structure of the microseisms fields and their parameters variations of in the earthquake preparation period, which permit recognition of the activation of the source processes long before appearance of the main shock and determination of the place and power of the future event.

New physical notions on characteristic seismic emissions associated with earthquakes have led also to development of criteria for the diagnosis and control of the stress state of earthquake source media.

CASE STUDIES. 1. The microseism anomalies registrations by the group of ordinary Caucasian network analog seismic stations (placed at the territory 550 km x 350 km).

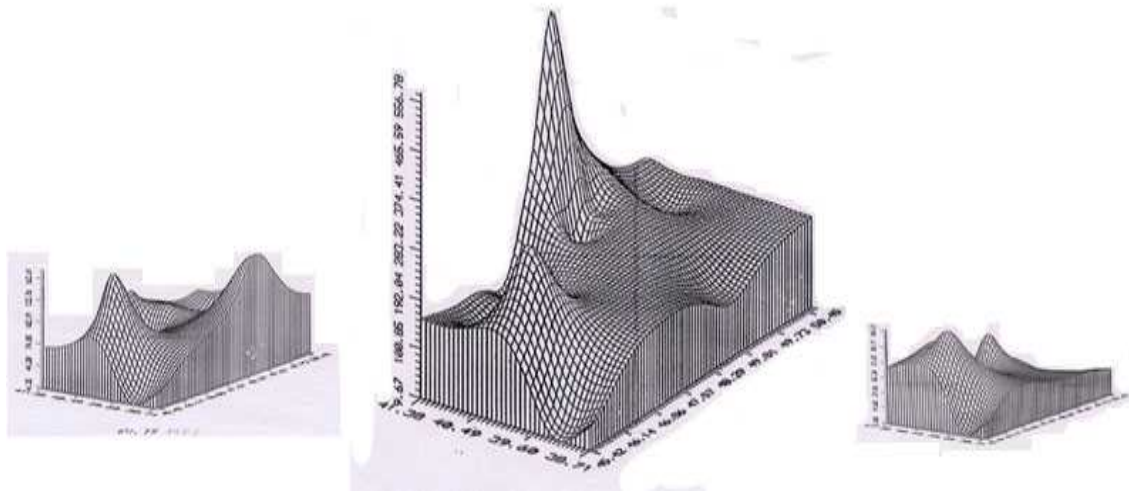
While analyzing archive data we found out more than seven hundred examples of the same kind of microseisms behavior changes registered event by the ordinary network stations with very low sensitivity but before the catastrophic events with magnitudes more than $M=7.0$.

Fig.1. Combined Caucasian maps of microseisms intensity changes 3 days and 1 day before and 1 day after earthquake in Caucasus on 07.12.1988 registered by group of Caucasian stations . They show that even 3 days before the events the level of microseisms intensity was anomalous.

3 days before

1 day before

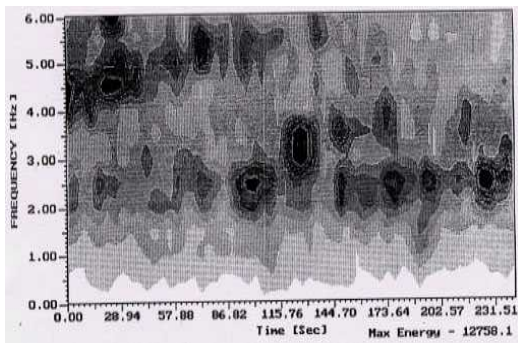
1 day after



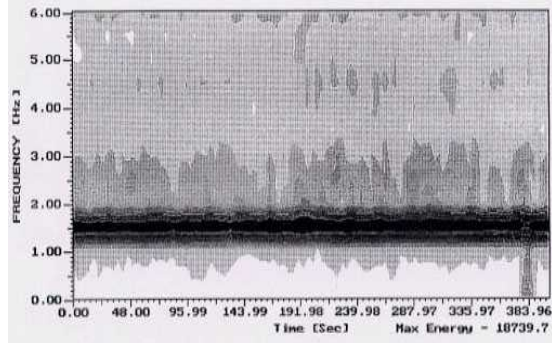
2. The microseisms anomalies registrations by digital seismological system “9690”

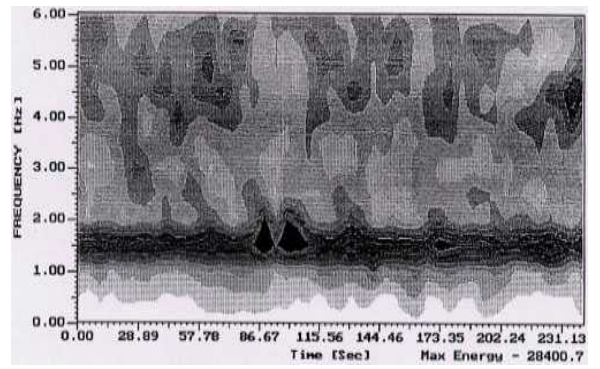
Fig. 2. Spectral – temporal analysis of the microseisms anomalies invoke by the earthquake in Ismailly region of Azerbaijan 15/10/1993, registered before and after the event.

4 days before



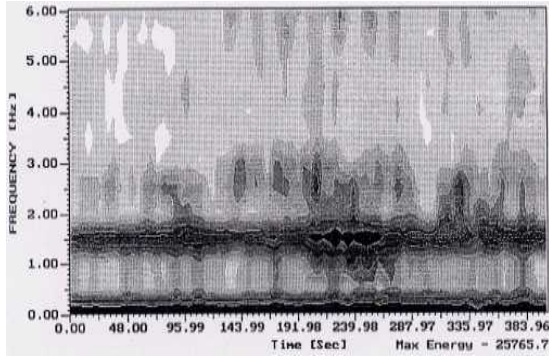
2 days before





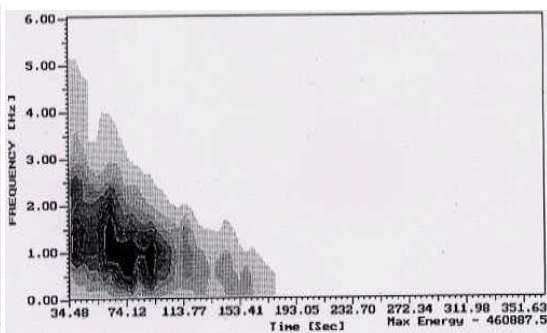
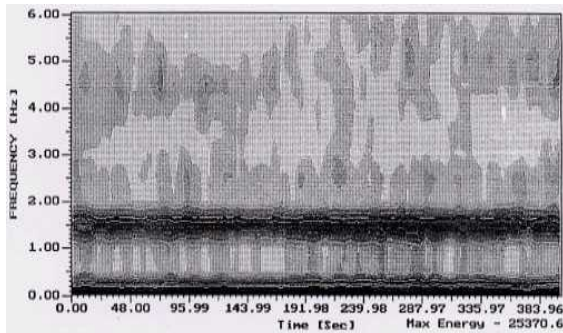
6 hours before

20 minutes before



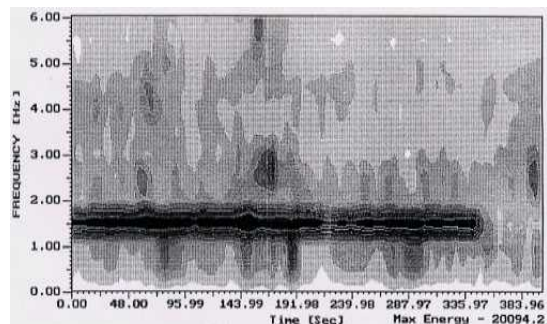
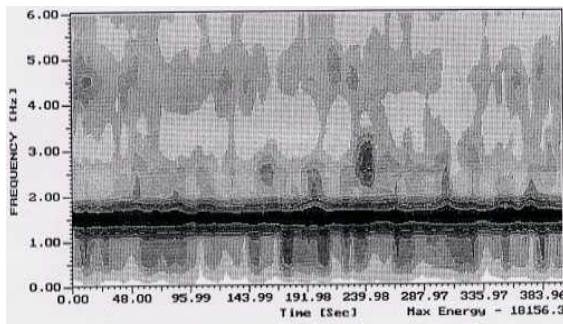
14 minutes before

In the time of event



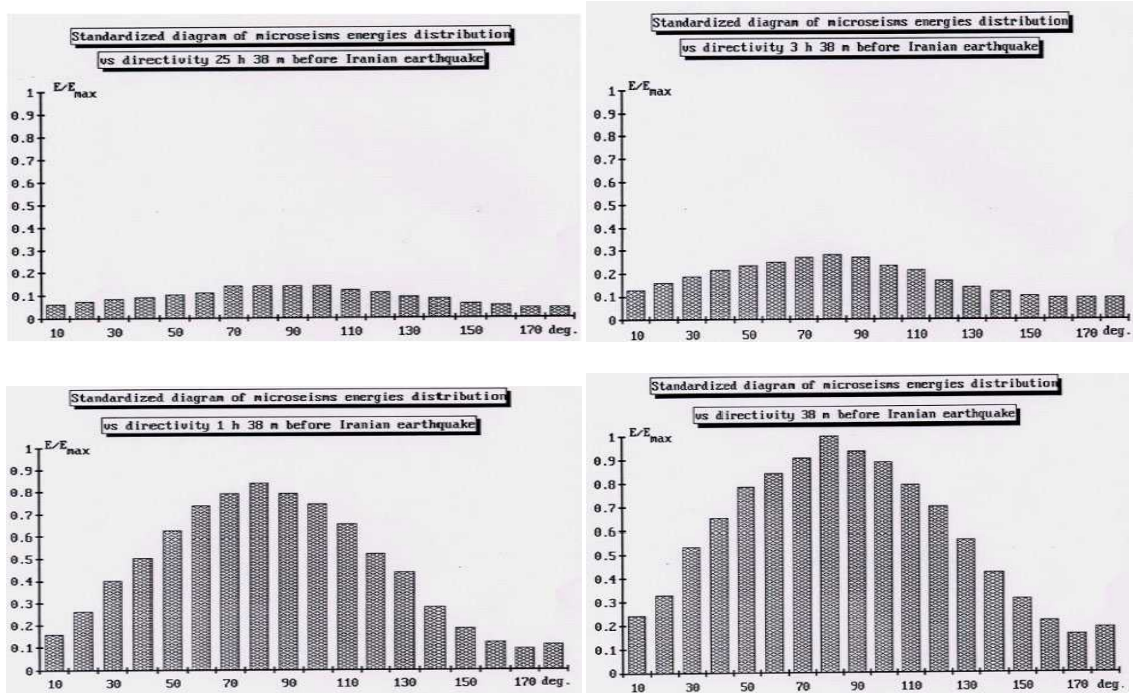
16 minute after

28 minutes after



3. The main parameters of anomalous microseisms. The main characteristic of the seismic emissions regularity before an earthquake: simultaneous decreasing of their dominant frequency; multi-stage increase in intensity; arising of the recurring impulses oscillations that are increasing in intensity and decreasing in time between their appearances; polarizing in the direction of the epicenter of the future earthquake.

3.1. Polarization properties. Fig. 3. Examples of seismic emissions 25h38m, 3h38m, 1h38m, 0h38m before an earthquake in Iran, Tebes, 19h 38m 21s, on September 16, 1978 polarized in the direction of the epicenter zone.

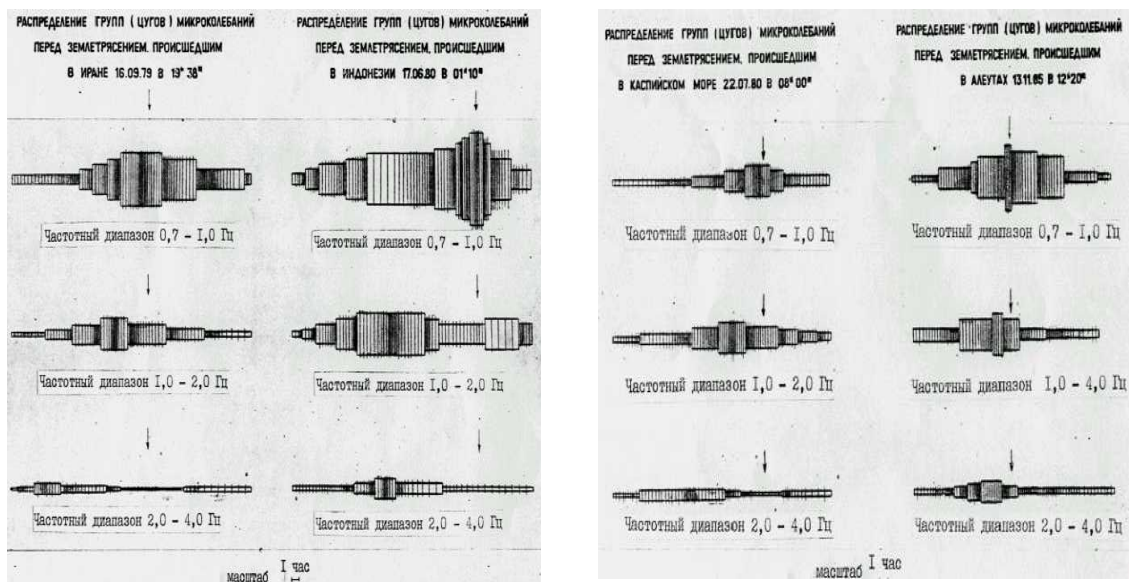


Examples based on observations clearly show the stability of polarization of the seismic signals in microseisms anomalies and of the possibility of accurate determination of the prospective source.

3.2. Multi-stage increase in intensity of seismic emissions before an earthquake

Fig. 4. Micro-impulses distribution in different frequency range and time before the earthquakes:

Iran 16.09.79, 19:35; Indonesia 17.06.80, 01:10; Caspian Sea 22.07.80, 08:00; Aleuts 13.11.85, 12:20



It has been revealed that several days or hours before the seismic events, depending on their magnitude, epicenter distance and geological conditions at the earthquake source sites, specific wave packets and groups of wave packets of micro-vibrations and separate short splashes of single waves are recorded. As time passes, they are replaced by a group of micro-impulses making a continuous chain, an appearance of a swarm with similar amplitudes. Then, against the background of this swarm, spasmodically appear separate micro-impulses with higher amplitude number, making a new swarm.

Afterwards, as spasmodically as before, separate micro-impulses appear with much bigger amplitude, which again transform into a swarm and so on, until an appearance of the main earthquake shock.

3.3. Table 1. Number of revealed anomalies of weak high-frequency noises, microseisms, invoked by registered earthquakes, occurred in different regions of the World during the period 1977 – 2005.

1. Number of anomalies registered by analogues seismological system	> 3000
2. Number of anomalies simultaneously registered by analog system	
- Azerbaijan – Tajikistan (1.5 months, 1977)	24
- Azerbaijan – Belarusian (3.0 months, 1979)	27
- Azerbaijan – Yakutia (3.0 months, 1985)	78
- Azerbaijan – Kyrgyzstan (1.5 months, 1986)	12
- Azerbaijan – Uzbekistan (3.5 months, 1987)	93
- Azerbaijan – Tadzhikistan (3.0 months, 1988)	22
- Azerbaijan – Kyrgyzstan (0.5 months, 1988)	6
- Azerbaijan – West Ukraine (2.5 months, 1989)	35
- Azerbaijan – Tatarstan (1996-2005)	> 500
3. Number of anomalies simultaneously registered by digital system	
- Azerbaijan – South Ukraine (3.5 months, 1991)	8
- Azerbaijan – North Iran (2.0 months, 1993)	5
4. Number of anomalies revealed during the analysis of strong and catastrophic earthquakes, registered by Azerbaijan regular seismological net from 1950 (archive data)	> 700
5. Number of anomalies revealed during the analysis of NORSAR net data and records of the seismological system “9690” Earth Data Ltd.	> 200
6. Cases of coincidence of registered anomalous manifestations with meteorological events	5 – 7 %
8. “Missing of the aim”	3 – 5 % (M>5.5)
9. “false alarm”	5 – 10 %

CONCLUSION:

1. We have discovered a reliable seismic precursor;
2. Have studied its amplitude, frequency and timing manifestations in period prior to earthquakes;
3. Have studied the influence of the stress state of medium on microseisms behaviour and distribution on the earth surface;
4. Have worked out criteria of seismic system to predict earthquakes on the bases of discovered precursor.

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