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New approach for geodynamical investigation of covered fracture zones and field geophysical ingenious technologies related to it. Eastern Carpatians (Vranchea zone) and Russian platform examples.

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A large percentage of the buried fractures are contained in thin unconsolidated, fluvial volumes. These objects are difficult to investigate by traditional seismic tools due to their complex spatial depositional patterns and rapid variations in fracture's material properties. We recently applied time-lapse microseismic techniques to some of these objects to determine if we could image the "non-effective" buried fractures and identify areas of present-day active ones. Vertical gravity gradients measurements offer the unique opportunity for research on the dynamics of mobile (weakened) tectonic units. Unlike most of marketed tools, this technique offers to compute the real density changes within the target area and possibly to predict the dangerous movements. Over a long period of time we have performed a number of complex geophysical (microseismic, tiltmeter, gravity gradient investigations) and geochemistry research (measurements of the Helium content existing in the natural waters) on the Russian Plate and Baltic Shield (regions in a vicinity of nuclear power stations). It was shown that the continental fracture zones are not the whole entities but rather sequences of mobile and immobile areas (blocks). As significant achievement, we mention the proved fact that before and during the seismic events the mobile areas demonstrate the increasing microseismic activity. Three recent technologies, high-precision gravity (including vertical gradient dg/dz measurements), microseismic fracture mapping, and earth's tilts (short period –10-30 sec) mapping, have been introduced in field practice

for quality control of buried fractures image and their animation before strong seismic events.

Microseismic investigations have included 2 types of measurements high-frequency (1-350 Hz) 3-C Passive seismic exploration (PSE) and low-frequency (0.03-15 Hz) Microseismic sounding method (MSM).

PSE. It is necessary to underline that vector energy dynamics and cross-spectrum response evolution are the best characteristics of real surface micromovements. We used as effective mapping parameters the next real time series : (a) vector energy (loading) logarithm – lg E, (b) loading - relaxation velocity logarithm – lg delta lg E/delta t, (c) slope of the spectrum response high cutoff as FI (so named Fault Indicator) parameter. As example, it is interesting to compare two series of mention parameters that have been determined in1999 and 2004 above Tulnici – Paulesti deep fault TPDF, seismogenic Vranchea zone.

Both series of field results (1999 and 2004) have demonstrated: 1) active consolidation of buried cracked sedimentary rocks and 2) surprisingly high velocity of process inside earlier destroyed Oligocene-Miocene formation. Really, the most probable FI values above axis part of TPDF for two dates are dramatically increased from 0,04 to 0,11.

MSM is based on physical properties of Rayleigh type waves and from point of its practical realization looks like microseismic survey at a number of spaced points. A special study showed that microseisms' spectra become firm in the frequency range lower than 1.0 Hz after stacking during approximately 1500 seconds or more. The continuous measurements on base point are organized to take into account and remove the influence of weather variations and industrial activities. The spatial analysis of distribution the signals amplitudes in connection with frequency lied in a base of the subsequent processing. To estimate the depth of the layer (H) controlling a resulting amplitude map we used experimental relation for Rayleigh waves between wavelength (λ) and thickness of "skin-layer", which is H$\sim \lambda/2$ (Gorbatikov,Kalinina, 2005).

Gravity measurements. The rational processing strategy was separated into two distinct stages relating to the degree of sophistication of the processes. The first stage represents rapid traditional field gravity methodology (with accuracy up to 0,01-0,02 mgls), while the second stage represents a more rigorous, expensive and time-consuming methodology (multiply measurements on the two levels, accuracy up to 0,1-0,3 microGals). The last study focuses on a computation of the possible density variations (e.g. linked with variable fluid activity or with destructive processes in f.z.).

Tilt measurements Original high-sensitive (up to 5 angle msce) portable computerized 2-C tiltmeters are intended to measure short-period (10=30 sec) tilts of the ground

surface. As a result of investigation of Intra-Moesian fault it is possible to mention: (1) MSM, first, confirmed its position and additionally allowed to see its continuation to the depth of 6 km, and second, allowed to reveal a wide fault zone with rather considerable width of 2-4 km. (2)The revealed by MSM fault western edge is clearly fixed by position of spectra maximum of tilts. (3)The position of fault axis is characterized by pronounced maximum of gravity gradient dg/dz, up to 100 E.

If compare with traditional methods of f.z. monitoring, it is necessary to underline that they usually performs using data collecting only from seismological results, GPS and traditional geodesy data.

It is possible to conclude that we have created and practically realized a certain new approach to delineation and spatial mapping of buried active faults. This approach includes the rigorous scientific criteria for determination of level of breakage and the present day activity, and potential geodynamical danger of the f.z. Accurate monitoring of weakened zone front movement along fracture's axis is essential part of our approach and our main interest.