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Vibroseismic interferometry method for monitoring temporal changes of Earth's crust stressed state

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Active methods of geophysical monitoring with seismic waves controlled sources are used for the investigation of the Earth's crust stressed-deformed state changes in volcanic, fault and seismic prone zones for the seismic hazard prognostics problems. A method is based on the use of wideband sweep signals and arrow-band harmonic signals radiated by seismic vibrators. To determine the sensitivity of the active monitoring system, some experiments to detect the influence of the Earth's crust tidal deformations (of the order of 10-7) on seismic wave velocities have been performed. A 100-ton seismic vibrator and recording systems were located at a distance of 356 km. The radiation sessions of harmonic and sweep signals were repeated every 3 hours during 8 days. This made it possible to construct the time series of variations in the amplitudes and phases of the signals and wave arrival times. Both 12-hour and 24-hour periodicities correlated with the Earth's tides were distinguished in the spectrum of variations of the recorded signals. The experiment has shown that the active monitoring system makes it possible to detect relative variations of the seismic wave velocities of the order of 10-5 - 10-6 in an area of 300-400 km around the source. This makes possible the direct monitoring of the state of stresses in an area of 100 thousand km2 to detect the regions and phases of the critical stress as an earthquake precursor. A few years ago the active monitoring of the Baikal lake region based on vibroseismic interferometry method have been started. The method is based on the seismic sounding of the region by powerful seismic vibrators with a long time radiation of narrow-band harmonic signals. The changes in the stressed-deformed state are determined through the variations of the amplitude-phase characteristics of stationary harmonic wave fields, which are excited in the Earth's crust due to a long-time radiation of harmonic signals

of constant frequency from the vibrator.