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Influence of local geological heterogeneities on forming the amplitudes of low-frequency microseismic field and sounding the geological medium with microsiesms

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It has been demonstrated both by numerical modeling and experimental observations that in a vicinity of geological heterogeneities of the Earth's crust one may observe certain distortion in a spectrum of low-frequency microseismic field. On the Earth's surface right above the inclusion with relatively higher seismic velocities, amplitudes of the given frequency f are decreasing, and vice versa amplitudes are increasing if the inclusion has relatively lower seismic velocities. The frequency f is dependent on depth H of the inclusion and the velocity of fundamental Rayleigh mode VR(f) as H=0.5VR(f)/f. The microseismic field itself is considered as superposition of fundamental Rayleigh modes with various frequency content. A new original technique of microseismic sounding which allows studying the deep subsurface structure of complex geological objects has been developed and verified at a number of test-sites.Results of microseismic sounding were compared with those obtained by common industrial geophysical methods and commercial drilling. Some practical application examples of the actual method of microseismic sounding for studying the various geological objects are presented including: 1) deep (up to 50 km) structure of the volcanic island; 2) deep (up to km) structure for several mud volcanoes; 3) deep structure of seismogenic faults; 4) 3-D deep (up to 45 km) subsurface structure of the giant natural gas field in Russia.