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High frequency measurement of P- and S-wave velocities on crystalline rock massif surface – methodology of measurement

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For the purpose of non-destructive monitoring of rock properties in the underground excavation it is possible to perform repeated high-accuracy P- and S-wave velocity measurements. This contribution deals with preliminary results gained during the preparation of micro-seismic long-term monitoring system. The field velocity measurements were made by pulse-transmission technique directly on the rock outcrop (granite) in Bedrichov gallery (northern Bohemia). The gallery at the experimental site was excavated using TBM (Tunnel Boring Machine) and it is used for drinking water supply, which is conveyed in a pipe.
The stable measuring system and its automatic operation lead to the use of piezoceramic transducers both as a seismic source and as a receiver. The length of measuring base at gallery wall was from 0.5 to 3 meters. Different transducer coupling possibilities were tested namely with regard of repeatability of velocity determination. The arrangement of measuring system on the surface of the rock massif causes better sensitivity of S-transducers for P-wave measurement compared with the P-transducers. Similarly P-transducers were found more suitable for S-wave velocity determination then P-transducers. The frequency dependent attenuation of fresh rock massif results in limited frequency content of registered seismic signals. It was found that at the distance between the seismic source and receiver from 0.5 m the frequency components above 40 kHz are significantly attenuated. Therefore for the excitation of seismic wave 100 kHz transducers are most suitable. The limited frequency range should be also taken into account for the shape of electric impulse used for exciting of piezoceramic transducer. The spike pulse generates broad-band seismic signal, short in the time domain. However its energy after low-pass filtration in the rock is significantly lower than the energy of seismic signal generated by square wave pulse.
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