

Study of daily industrial explosions at the Kumtor deposit, Kyrgyzstan, in 2020–2021

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Abstract Temporary changeability in the velocity properties of the Tien Shan lithosphere within the coordinates $\varphi=41.47-41.52^{\circ}\text{N}$, $\lambda=78.10-78.16^{\circ}\text{E}$ was noted as a result of determination the seismic waves velocities from industrial explosions in the Central Pit in 2020–2021 based on the data from digital stations “Taragai” (TARG), “Kajy-Say” (KDJ), “Karakol” (PRZ). The values of V_p vary from 5.6 to 7.6 km/s, V_s - from 3.3 to 4.3 km/s, V_p/V_s - from 1.59 to 1.82, which differ from the velocity values determined in 2017–2018. Intervals with different coefficients of values of growth and decline, components of nonlinear “rhythmic components” - nonlinear cycles of different orders are marked gradually in the sequence of manifestation of the seismic waves’ velocities from explosions. VP seismic waves cycles, for example, of the third order are determined at a value of $V_p \geq 6.9$ km/s based on a step-by-step assessment of polynomial trends. The third-order cycles’ duration is 28–117 days; the second-order cycles’ duration is about 154 days. Cycles, for example, of the third order are determined at a value of $V_s \geq 3.9$ km/s based on a step-by-step assessment of polynomial trends in the V_s sequence. The third-order cycles’ duration is 28–117 days; the second-order cycles’ duration is more than 117 days. Cycles, for example, of the third order are determined at a value of $V_p/V_s \geq 1.75$ based on a step-by-step assessment of polynomial trends on the variation of V_p/V_s . The third order cycles’ duration is 9–65 days; the second order cycles’ duration is about 67–95 days. It is assumed that changes in the velocity properties of a section of the lithosphere are likely associated with changes in the elastic moduli of the medium based on the widely known relationships in seismology between the longitudinal waves’ velocity, transverse waves’ velocity, compression modulus, shear modulus, and density of the medium. Thus, the shear modulus values in the area under consideration vary from $3.1 \cdot 10^{10}$ dyn/cm² to 5.410^{10} dyn/cm². It is noted that daily industrial explosions affect the environment and geodynamics of the Tien Shan lithosphere through the accumulation and pumping of seismic energy and vibration. Manifestation probabilities of fluids, partial melting and high pressures in the studied area of the Tien Shan orogeny are shown based on the ratio of $V_p, V_s, V_p/V_s$ of industrial explosions.

Keywords Quarry explosion, longitudinal wave, transverse wave, seismic waves’ velocity, cycle of variations in seismic wave parameters, hierarchy of cycles, manifestation of fluids, partial melting, high pressures.

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