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Ultrasonic time-frequency method to evaluate the deterioration properties of rock suffered from freeze-thaw weathering

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Abstract:

Cyclic freeze-thaw (F-T) is a serious natural weathering for rock engineering and stone constrictions in cold region. Considering the universality and destructiveness of rock F-T weathering, evaluation of rock deterioration is of vital importance. In this work, ultrasonic detections and mechanical experiments including uniaxial compression, splitting tension and angle-changed shear tests were carried out on red-sandstone specimens without and after different F-T cycles. Attenuation occurred to almost all of the indexes of red-sandstone after F-T weathering, including mechanical properties such as uniaxial compressive strength (UCS), deformation modulus (E_d), splitting tensile strength (STS), cohesion (C) and friction angle (ϕ), and ultrasonic properties such as the P-wave velocity (V_p), head-wave amplitude (A_h), centroid frequency (f_c) and kurtosis of frequency spectrum (KFS). After 25 F-T cycles, the UCS, E_d, STS, C, ϕ, V_p, A_h, f_c and KFS decreased by 42.5, 63.0, 87.3, 33.7, 22.6, 50.6, 24.6, 38.3 and 0.56 %, respectively. With the increasing F-T cycles, similar convergent decrease tendencies between the UCS, E_d, STS, C and the V_p, A_h, f_c, KFS were found, confirming the effectiveness of ultrasonic time-frequency method to estimate the deterioration of rock suffered from F-T weathering. Similar degradation behavior in ultrasonic time-frequency properties and in mechanical properties resulted from the

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