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Parameters of Seismic Velocities and their Relationship to the Geomechanical Characteristic of the Podlesí Granites

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In the Czech Republic, the optimal rock environment for geological waste disposal is granite. The ongoing research aims to analyze and evaluate rock matrix properties across a range of granites within the Czech Republic. Thegeophysical, physical, and geomechanical parameters of the Podlesí granites in the western part of the Krušné hory Mts., near the village of Potůčky are analyzed in the presented study.

The samples were collected at depths of between 35 and 105 metres. Seismic P-wave and S-wave velocities were measured using ultrasonic scanning. The samples were water-saturated, unsaturated, and dried. The measured data were used to calculate dynamic Young's modulus, dynamic shear modulus, and Poisson's ratio. The deformational characteristics of the rock were specified from uniaxial loading. The shear and longitudinal deformation of each sample was measured using a resistive strain gauge fixed directly on the sample. Intermittent loading of the symplex proceeded using a uniform gradient of axial stress of 1 MPa.s-1. Static Young's and shear modulus, and Poisson's ratio were calculated.

All the obtained data demonstrate a correlation between the properties of the granite and depth within the borehole. P-wave velocities do not show any anisotropy in the studied samples, their velocities vary from 4.15 km.s-1 to 6.03 km.s-1 while S-wave velocities vary from 2.74 km.s-1 to 3.63 km.s-1. The highest velocities were measured in the saturated samples while the lowest velocities were measured in the dried samples.

Dynamic Young's modulus varies from 42.5 GPa to 83.9 GPa while static Young′s modulus varies from 31.4 GPa to 57.1 GPa. Dynamic Young's modulus is approximately 44% higher than static Young's modulus. Dynamic and static shear moduli show a similar relationship. Dynamic shear modulus varies from 19.0 GPa to 34.5 GPa whist static shear modulus varies from 13.0 GPa to 23.4 GPa. Poisson's ratio between 0.16 and 0.25 was measured. The porosity of the studied granites decreases with depth until 85 metres. However, at about 100 metres, the porosity increases. The highest porosity was found to be about 3.9 % while the lowest was about 0.6 %. The granite matrix porosity correlates very well with the quantity of albite, which probably contains a significant amount of pores.

All the measured data point to the same conclusions. With depth there are increases in seismic velocity, Young's modulus, static modulus, dry density, and compressive strength. With depth the porosity decreases. Poisson's ratio is not influenced significantly by depth. These conclusions specifically relate to the protolith granite. At a depth of about 90 metres, there is a transition zone between the protolith granite and the biotite granite. This transition zone markedly influences data derived from depths below $\sim$ 85 m. The results presented here suggest that this transition zone is in fact wider than previously supposed. It would, therefore, be useful to study the influence of saturation on the static modulus in order to compare it with the dynamic modulus.