

Physical and geomechanical characterization of volcanic rocks from Styria

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This study analyses the dependence of various rock mechanic parameters on geological characteristics for volcanic rock from Styria. It is common for ground models to only focus on geologic parameters or geotechnical parameters, but not both. Therefore, it is important to determine which geological characteristics have the greatest influence on the geomechanical parameter. In this study four parameters – density, porosity, wave velocity, and uniaxial compressive strength – were tested to demonstrate this for a set of volcanic rocks from Styria. Four grey trachyandesite and three red trachyandesite samples from the Klausen quarry and one basalt sample from the Klöch quarry provided the data used in this analysis. The red trachyandesites appear from visual observation to be altered versions of the grey trachyandesites, whereas the basalt appears unaltered. The samples were cored and a series of physical and mechanical experiments were conducted on the cores. The data collection procedure for each core sample started with the measurement of the dry density, saturated density, and porosity. Then, an ultrasonic device was used to determine the p- and s-wave velocities to calculate the dynamic elasticity moduli. Lastly, the cores were deformed in a compression testing machine to the maximum stress upon which macroscopic failure occurred, and the resultant stress and strain profiles were recorded. Data from these experiments indicate a linear relationship between porosity and density, a linear relationship between compressional and shear wave velocities, that basalt and grey trachyandesite exhibit brittle behaviour whereas red trachyandesite exhibits brittle-ductile behaviour, and that porosity influences the peak strength as well as static and dynamic modulus of elasticity. The peak strength, p-wave velocity and density also correlate to the lithological characteristics, showing a progressive increase in all three parameters from the altered red trachyandesite (acidic to intermediate) to the unaltered grey trachyandesite (acidic to intermediate) towards the basalt (mafic). These findings show that the geological characteristics of volcanic rocks from Styria have a direct influence on the physical and geomechanical characteristics, as also observed for volcanic rocks from other locations.