論文の内容の要旨

Laboratory reproduction and microscopic observation of mechanical weathering process of soft rocks

（軟岩の機械的風化過程の再現とその顕微鏡観察）

儂　学鋒

Rock is an important material which is used widely in construction nowadays. In a particular environment rock is always affected by two different types of weathering: physical weathering and chemical weathering. Physical weathering which this study concerns is the particular weathering that is caused by temperature change under water and pressure actions. Physical weathering is also a key cause of geologic hazard of rock slope and landslide. On July 19, 2012, a landslide that was caused by rainfall killed 4 people in eastern Indonesia. On January 12, 2013, landslide caused by snow thaw buried 46 people including 19 children in Yunnan Province, China. On May 12, 2013, rock fall due to weathering buried 8 people in Guizhou Province, China. In these geologic hazards, the behavior of water played a key role. When water turns into ice, the volume increases by 1/9. After freeze-thaw process, cracks in rock increases, leading to deterioration of material properties and finally failure.

The present study pays special attention to the relationship between shear wave velocity and shear strength of soft rock by conducting triaxial compression tests. Samples were subjected to a weathering process that was induced by temperature change, including possible effects of water and freezing. One weathering cycle consisted of vacuum saturation (-98kPa, 72 hours), freezing (24 hours) and heating (24 hours) in conjunction with measurement of shear wave velocity. Further, point load tests were conducted on anisotropic rocks to study the deterioration of mechanical properties in directions normal and parallel to the joint plane.

Study was also made of the surface change of isotropic and anisotropic material, which was observed by a microscopic instrument. It was aimed to study the deterioration in terms of crack density and mineral movement due to freeze-thaw weathering process. The crack density was obtained by a laser scanning microscope and the mineral movement was analyzed by particle image velocimetry.

In-situ tests including dynamic cone penetration tests and seismic refraction tests were conducted at Taziping landslide, China and Mt. Shichimen landslide, Japan. These two experiments revealed that the surface weathered layer is shallow (up to 2.3m) and has a shear velocity range of 50-400m/s. It was also delineated that a field shear apparatus was successfully defined and implemented to get the accurate shear strength of weathering layers. A relationship between shear strength and shear wave velocity was established for the quick estimation of shear strength by measuring shear wave velocity in the field.

Keywords

Rock weathering; mechanical properties; microscopic observation.