

Geomechanical properties of weathered granites

The weathering of granites can be described and classified in different scales. These scales are: the single minerals, the petrological structure of rock and soil, the jointed rockmass and the faulted rock. For a detailed description of weathering profiles of granites it is necessary to look at these scales. The mineralogical, petrological and technical properties of a granite change with proceeding weathering. The discussion of changes of mineralogical, petrological and technical properties of a granite with proceeding weathering is based on a series of laboratory tests, mapping and fieldwork of five different granites. These granites are: fine to medium grained Tittlinger Granit (Bayerischer Wald, Germany), coarse grained Weinsberger Granit (Oberösterreich, Austria), porphyric medium to coarse grained Weißenstadt-Marktleuthener Porphygranit (Fichtelgebirge, Germany), medium to coarse grained Thüringer Biotitgranit (Thüringer Wald, Germany) and medium grained Königshainer Granit (Oberlausitz, Germany).

In the first part of the thesis the results of mineralogical and petrological analysis show the different paths and mechanisms of weathering of silicates. The evolution of weathering of granites in scale of minerals and in scale of granite texture is described by the results of photo- and electronmicroscopical analysis. A general classification system with 6 different stages of granite weathering from fresh granite to totally decomposed and totally altered material is given in scale of structure and texture. This classification includes the mechanical destruction of texture and structure as well as the chemical and mineralogical decomposition and alteration of the different minerals. Therefore with this classification system it is possible to distinguish between granites that underwent a chemical dominated weathering process and granites that underwent a physical dominated weathering process.

It is already well known - especially for granites - that the porecontent increases with increasing weathering stages. This thesis shows the evolution of porecontent on dependence of increasing weathering stages for five different granites analysed with different methods which are: physical determination of porecontent and bulkdensity by weight, point counting method on thinsections and digital picture analysis of thinsections. Pore content is shown to be a reliable measure of the stage of weathering of granitic rock material. A series of rock strength tests was carried out on samples of different weathering stages from fresh rock material to altered rock material for all five types of granite. The changes of strength and of stress strain behaviour became obvious: even in early stages of weathering, where changes in rock material can be detected only by microscope, the loss of strength is at about 40 to 70% of the strength of fresh rock material. The dependence of rock strength on content of porewater became also obvious: saturated wet samples of even slightly weathered granite have a significantly reduced unconfined compressive strength in comparison with dry samples of the same stage of weathering. Tests with supersonic waves on a series of samples of granite of different stages of weathering show that the velocity of supersonic p-waves is a reliable measure for the weathering stages. The effect of grainsize on rockstrength parameters is also discussed by a series of tests of different fresh types of granites ranging from fine grained Tittlinger Granit to coarse grained Weinsberger Granit. Rock strength rises with decreasing grainsize.

The studies of weathering of jointed granitic rockmasses in the field (quarries and tunnel excavations) result in a detailed description and classification of weathering grades for jointed rock masses. Three typical weathering profiles can be distinguished: 1) the tropical profiles which are dominated by chemical weathering, 2) weathering profiles which are dominated by physical weathering, 3) weathering profiles as a result of both – physical and chemical weathering. These three types are different in composition and technical properties. In addition to the weathering classifications after ISRM and IAEG a new classification is given for jointed granites which are dominantly weathered by physical processes.

The last part of the thesis deals on the base of case studies with the influence of the different weathering profiles on rock classes and tunneling works as excavation and support. The method of excavation varies with the weathering grade and the joint distances. Fresh nonjointed granite is excavated by blasting. In moderate weathered well jointed granites blasting is used for loosening. Rock classes vary with the weathering grade and the joint distances.