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ENGINEERING GEOLOGICAL CLASSIFICATION OF FAULT ROCKS

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SUMMARY

Brittle faults are extraordinarily important in rock engineering. The geotechnical problems related to faults include their substantial heterogeneity with regard to internal structure, abrupt variations in weak and strong rocks components, and groundwater. The extreme complexity of brittle faults makes their geotechnical characterisation and investigation difficult. The importance of evaluating specific geometrical and geomechanical features of "block-in-matrix"rocks for the engineering geological characterisation of fault zones is emphasised. A functional, diagnostic classification of fault rocks is introduced, based on our experience from investigation and construction of rock structures such as dams, slopes and tunnels, and consideration of the results of recent research.

INTRODUCTION

Most serious geotechnical problems related to rock engineering are generated by brittle faults. Despite the tremendous importance of faults in engineering practice only little is known about the engineering properties, characterization and identification of faults. The objective of this short version of a paper published by Riedmüller et al. (2001) is to present a diagnostic engineering geological classification of fault rocks.

Brittle faults are common features of the upper crust. They are complex structures resulting mainly from brittle deformation. Consequently, faults have the highest impact on the rock mass properties. The predominant small-scale deformation mechanisms of brittle faults are mechanical damage processes such as micro-cracking, fragmentation, grinding with rigid-body rotation and frictional wear. These processes result in grain size reduction, dilatancy and a dramatical drop in strength as compared to the source rock ("protolith"). Low-temperature solution transfer contributes to the alteration of brittle faulted rocks through transformation and neoformation of clay minerals and/or other secondary minerals (carbonates, oxides etc.). As a result cohesionless "soil-like" or cemented cataclastic rocks develop, such as gouge, cataclasite, breccia and pseudotachylite.

CLASSIFICATION OF FAULT ROCKS

Due to the shortcomings of previous attempts to classify rocks resulting from brittle faulting, a diagnostic functional classification which is based on experience from investigations for, and construction of, rock structures such as dams, slopes and tunnels, and on the results of recent research is proposed.

The classification proposed here considers both matrix and block characteristics, as well as secondary cementation since the combined contributions of these components together determine the performance and strength of the faulted rock mass.

The basic classification of the rocks produced by brittle faulting, for which we suggest the term cataclastic rocks, consists of the differentiation between the cohesive or noncohesive character of the faulted rock, i. e. whether it has the properties of hard rocks or else of soil-like material (Figure 1).

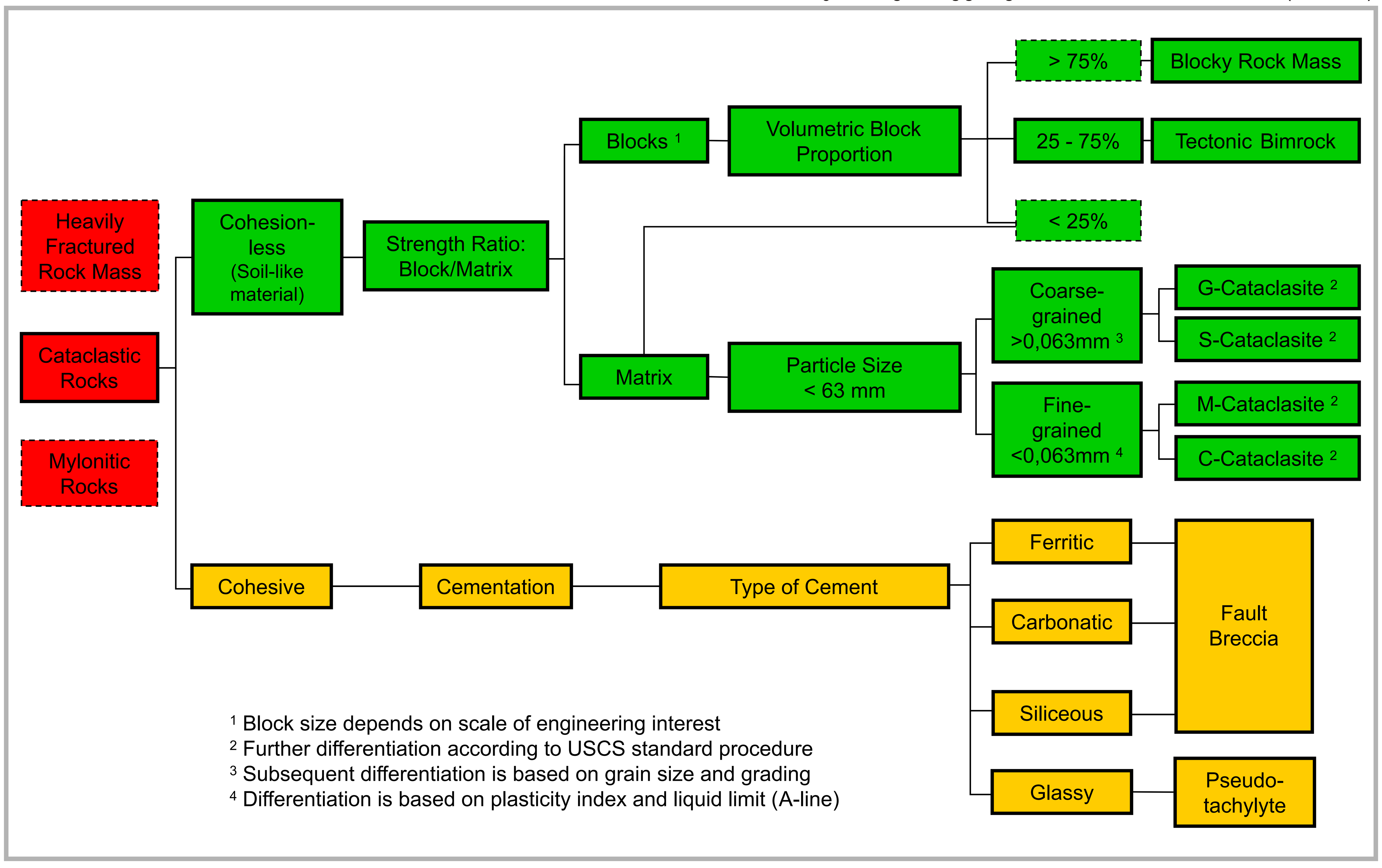
For cohesive cataclastic rocks, the strengths of both fragments and cementing material, as well as the degree of cementation, determine the rock properties. Cemented fault rocks (fault breccia, pseudotachylyte) may be subject to the same characterisation methods as used commonly for hard rocks.

The differentiation of cohesionless cataclastic rocks is based on the identification of geotechnically significant blocks, in which blocks have a strength contrast relative to the matrix, and the block sizes and block volumetric proportions are sufficient that they influence the mechanical behaviour of the fault rocks.

Blocks are mechanically distinct from matrix if there is a contrast between the strength or stiffness of the blocks and the strength or stiffness of the matrix. For example, based on the laboratory experience of Lindquist (1994), Medley (1994) proposed a minimum strength contrast based on a friction angle ratio (tan φ of weakest block)/ (tan φ of matrix) of between 1.5 and 2.0.

The differentiation of the matrix follows the standard procedures used in soil mechanics to describe and classify soils (Unified Soil Classification System, British Standard Institution). The principal classification parameters are particle size distribution and plasticity, from which the soil name can be deduced. Following the engineering soil description, we suggest differentiation between gravel, sand, silt and clay dominated cataclasite (G-, S-, M- or C-cataclasite). The name cataclasite is used for cohesionless, soil-like matrix material which is a product of rock deformation (cataclasis) accomplished by pervasive brittle fracturing and comminution of the grains. The name coarse-grained (>63 µm) or fine-grained (<63 µm) cataclasite is used if further differentiation is not required, or not possible. Instead of fine-grained cataclasite the term gouge, which is very common in engineering geology, can be used. Gouge can be further differentiated into clayey or silty gouge, if possible.

Figure 1: **Engineering geological classification of catacalatic rocks (fault rocks).**



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