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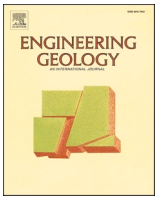

Practical classification of geotechnically complex formations with block-in-matrix fabrics

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ABSTRACT

The terms "bimrocks", "bimsoils" and "soil-rock mixtures" indicate different and very common types of geological units with a block-in-matrix fabric that are also "geotechnically complex formations" and are characterized by an internal heterogeneity, and spatial variability of mechanical parameters and lithological compositions. Due to this internal complexity, the understanding of their geomechanical behavior presents a key challenge in geotechnical engineering. However, the lack of a standardized and clear terminology complicates the discrimination of different types of complex formations and their internal mechanical properties, which leads to inconsistency in the literature and research studies. This inconsistency causes misunderstandings, with possible practical implications for the characterization, analysis, design and construction of engineering works. By a combination of geological and geotechnical observations, we propose a new classification for geotechnically complex formations, with particular attention to those with a block-in-matrix internal fabric. Four properties are at the base of this new classification and have a primary role in controlling the geotechnical behavior of block-in-matrix units (bimunits): (i) the composition (i.e., lithology, degree of lithification/consolidation, nature, and rheology) of blocks and the matrix that affects the water sensitivity, (ii) the degree of internal anisotropy (DA) of the block-in-matrix fabric, (iii) the degree of stratal disruption and mixing, and (iv) the volumetric block proportion (VPB). As a result, we classified bimunits in those with "anisotropic", "isotropic", and "mixed" (i.e., different behavior depending on the DA of the matrix) textures and, each of these types, into block-in-matrix rocks and block-in-matrix soils (bimrocks and bimsoils in the following). According to the water sensitivity of the matrix, bimrocks are also differentiated into "hard" and "soft". The novelty of the classification is that it is not limited to few types of geotechnically complex formations (e.g., flysch) but it can be easily applied to all field-based investigations of the different types of complex formations, regardless of their internal degree of stratal disruption, composition, and mechanical response to water sensitivity.

1. Introduction

At the scale of engineering works, geotechnically complex formations are rock units or soils that have lithological and/or structurally discontinuities with contrasting geomechanical properties (Barla and Perello, 2014; Cancelli, 1986; D'Elia et al., 1986; Harrison, 2014). Complex formations include mélanges, "argille scagliose"/scaly clays, flysch deposits, etc., which together form significant component of geomaterials worldwide. The most difficult complex formations to geotechnically characterize and model are those with block-in-matrix internal arrangements ("fabrics") because of the presence of hard blocks, ranging in size from centimeters to kilometers, with differing geologic natures (e.g., sedimentary, crystalline, igneous intrusive, volcanic, metamorphic, etc.), lithology, orientation, shape and rheology, which are embedded in a softer matrix of different composition (e.g., clay, mud, sand, etc.; see, e.g., Afifipour and Moarefvand, 2014; Gokceoglu and Zorlu, 2004; Kalender et al., 2014; Medley, 1994, 2004; Napoli, 2021; Napoli et al., 2021a, 2021c, 2021b, 2018; Tsesarsky et al., 2016). The high internal heterogeneity and compositional variability of block-in-matrix units ("bimunits" in the following), which is mainly due to the strong rheological contrast between blocks and the matrix, extends the geotechnical complexity over a wide spectrum of complex

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