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Weathering of the Valle Ricca clay

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Wide areas of the Italian peninsula have outcrops of very stiff clay formations of Pliocene-Pleistocene age, commonly referred to as blue-grey clay formations. These clays were emplaced in different geological-structural settings of the Apennines, ranging from the marine foredeep to intra-montane basins filled during the orogenesis or to marine-lacustrine basins formed during the opening of the Tyrrhenian Basin. A distinctive feature of this lithotype is its color: from blue-grey, when freshly cut, to yellowish, when exposed to weather agents. As is known, the gradual transition from blue-grey to yellowish is dependent on Fe oxidation and it represents the most impressive macroscopic effect of chemical weathering.

The geotechnical literature provides details on the impact of weathering in terms of changes in the state, in the geomechanical properties and, to a lesser extent, in the texture of weathered and unweathered material from blue-grey clay and similar clay. Cafaro and Cotecchia (2001) demonstrated that weathering of blue-grey clay causes a breakdown of its bonding, reduces the size of its state boundary surface and decreases its normalized shear stiffness. By contrast, the chemical-mineralogical changes that progressively turn clay from blue-grey to yellow are not supported by equally detailed data.

The Valle Ricca site selected for the study is located at the northern boundary of the territory of the Municipality of Rome. For the past three decades, the studies conducted on the blue-grey clay outcropping in this area have been so numerous as to represent landmarks in the field of Soil Mechanics. In the 1980s, the Valle Ricca clays were identified as a geological formation suitable for being used as a repository for deep storage of waste including radioactive waste. As a result, their geochemical properties (Antonioli and Lenzi, 1984) and, namely, their oxidation processes were thoroughly investigated.

The present study proposes a weathering model of the Valle Ricca Pliocene-Pleistocene stiff and jointed blue-grey clay transforming into yellow clay. Physical, mineralogical, chemical and textural changes, as well as the weathering profile of the outcropping clay were investigated. In-situ surveys were carried out in order to characterize the local geological-structural setting, to reconstruct the present weathering profile and to establish the jointing conditions of the investigated material. Furthermore, a number of samples were collected and lab-investigated. In particular, diffractometric mineralogical analyses, bulk chemical analyses, textural analyses and geotechnical tests were conducted on blue-grey and yellow clay samples collected along some stratigraphic horizons.. Each of the investigated experimental fields gave useful insights into the dynamics of weathering. An overall schematic model of the chemical-physical changes of the Valle Ricca blue-grey clay was built from the integrated set of data collected in this study and of related interpretations and inferences.

References:

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Cafaro, F., and Cotecchia, F., 2001, Structure degradation and changes in the mechanical behaviour of a stiff clay due to weathering: Géotechnique, v. 51, p. 441-453.