Geophysical Research Abstracts
Vol. 13, EGU2011-13348, 2011
EGU General Assembly 2011

Weathering effects on the mechanical behavior of calcarenites: experimental evidences and impact on the stability of costal cliffs and cavities

Riccardo Castellanza (1), Matteo Ciantia (1), Claudio di Prisco (1), Federico Agliardi (2), and Giovanni Crosta (2)

(1) Italy, Department of Structural Engineering, Politecnico di Milano (riccardo.castellanza@polimi.it), (2) Italy, Department of Geological Science and Geotechnologies, Università di Milano Bicocca (giovannibattista.crosta@unimib.it)

Long sectors of the Apulian coast (SE Italy) are formed by steep rocky cliffs in fractured and weathered carbonate soft rocks (e.g. calcarenite and Bari Limestone). These weak/soft rocks, especially the calcarenite, are strongly affected by weathering processes that markedly reduce the mechanical properties with time. As a consequence, cliffs and underground cavities are affected by intense erosion and instability.

In the present work we present the results of an experimental campaign aimed to define the main weathering processes that affect the soft and porous Plio-Pleistocenic calcarenites formed by the weak cementation of calcareous grains originally unbounded. The grains of heterogeneous origin are microscopic fragments of calcareous shells. Diagenetic processes transform this material in a rock similar to a coarse cemented sand where both grains and bonds are calcitic (98% of $CaCO_3$) with an average porosity of about 0.52 and an average pore size dimension of about 0.10 mm.

We carried out a series of laboratory tests including: uniaxial compressive tests, indirect tensile tests, soft oedometer tests and triaxial tests. Creep tests under controlled "weathering" conditions were appositely designed by applying a constant load and a controlled water flux on the sample.

The field and experimental results show three main weathering controlled behaviors:

a) a marked and instantaneous strength reduction, up to 50% of the dry initial value (UCS 1.5 MPa), when increasing the degree of saturation to 1;

b) a slow strength reduction induced by the progressive chemical de-bonding as a consequence of dissolution reactions; this process has been studied by exposing the calcarenite to different environmental conditions simulated by a flux of distilled water, acid solution or saline water;

c) a physical-mechanical erosion by marine wave actions.

The main geomechanical aspects of these processes have been studied and are presented, and discussed in detail at a micro-structure and micro-fabric scale (bonds and grains). Observations by SEM, thin sections and X ray CT analyses substantiate the interpretation of the controlling physical chemical processes. As a consequence, in order to assess and eventually predict the stability of costal sites and underground cavities, all the involved weathering processes and their degree of coupling should be recognized and considered in the modeling phase. A coupled chemo-mechanical approach is proposed for the geomechanical modeling starting from the experimental evidences. Preliminary results of small scale boundary value problems suggest that this approach allow a more reliable risk analysis for large scale instabilities.