



Experimental Determination of Hydraulic Properties of Unsaturated Calcarenites

Antonietta Celeste Turturro (1), Gioacchino Francesco Andriani (2), Maria Clementina Caputo (1), and Sabino Maggi (3)

(1) CNR National Research Council - IRSA Water Research Institute, (2) Dipartimento di Scienze della Terra e Geoambientali, Università degli Studi di Bari "Aldo Moro", (3) National Research Council Water Research Institute via De Blasio, 5 -70032 Bari Italy

Understanding hydraulic properties is essential in the modeling of flow and solute transport through the vadose zone, to which problems of soil and groundwater pollution are related. The vadose zone, in fact, is of great importance in controlling groundwater recharge and transport of contaminants into and through the subsoil.

The aim of this work is to determine experimentally in laboratory the hydraulic properties of unsaturated calcarenites using an approach including petrophysical determinations and methods for measuring water retention. For this purpose, samples of calcarenites belonging to the Calcarenite di Gravina Fm. (Pliocene-early Pleistocene), came from two different quarry districts located in Southern Italy (Canosa di Puglia and Massafra), were utilized. The water retention function, $\theta(h)$, which binds the water content, θ , to water potential, h , was determined in the laboratory by means two different experimental methods: the WP4-T psychrometer and the suction table.

At last, a simple mathematical equation represented by van Genuchten's model is fitted to the experimental data and the unknown empirical parameters of this model are determined.

Textural analysis on thin sections using optical petrographic microscopy and evaluation of total and effective porosity by means of standard geotechnical laboratory tests, mercury intrusion porosimetry and image analysis were also performed. In particular, a comparison between mercury porosimetry data and results of photomicrograph computer analysis through the methods of quantitative stereology was employed for providing pore size distributions.

The results of this study identify the relationship between the hydraulic behavior, described by the water retention function, and pore size distribution for the calcarenites that are not easy to hydraulically characterize. This relationship could represent a useful tool to infer the unsaturated hydraulic properties of calcarenites and in general this approach could be applied to be used for different kinds of rocks.