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PERMEABILITY CHARACTERS OF APULIAN RED SOILS AND THEY INFLUENCE ON RUN-OFF IN APULIAN KARST ENVIRONMENT

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The aim of the present study is to examine the influence of red soils coverings on run-off and and hydro-geologic vulnerability in Murgia area and piedmont.. The capacity of rain waters to infiltrate through the rd soil depends both on soil permeability and rainfall intensity. Whereas permeability, i.e. infiltration rate, is lower than rainfall intensity, backwater ponding or rilling will take place, depending on superficial geomorphology. The present study has shown that in-situ hydraulic conductivity can remarkably vary in quite a wide range as a function of the initial water content and therefore it can condition significantly the permeability of outcropping calcareous formations. As a consequence, infiltration and superficial runoff phenomena can be largely influenced.

Within the present study 33 permeability tests have been performed: 19 of them carried out during winter time characterized by continuous and prolonged rainfalls and 14 during the spring season, relatively dryer. A Guelph permeameter was used for in situ permeability tests working at constant head according to the same principle of Mariotte bottle.

During the wet period the soil permeability resulted very low (about 10^{-5}-10^{-6} cm/s), making particularly the tests much difficult to be carried out. Sometimes two days were needed to complete a single test. In spring time, permeability values measured resulted much higher (about 10^{-3}-10^{-4} cm/s). Therefore the overall set of performed tests pointed out how permeability of red soils is largely influenced by the initial water content. Permeability values may distinctly vary more than one order of magnitude as a function of initial water content. The process leading to permeability variation derives from hydration phenomena and is very slow. At low permeability values stationary flux conditions can be reached before hydration of the soil is complete.

This phenomena lead to remarkable implications on hydraulic land vulnerability: while soil covers characterized by a permeability of $5*10^{-4}$ cm/s can absorb entirely rainfalls having discrete intensities (up to 50 mm/h), whenever permeability rises to 10^{-3} cm/s high intensity rainfalls (up to 90 mm/h) can entirely infiltrate. If permeability drops to 10^{-5} cm/s only low precipitations (less than 2 mm/h) can be absorbed while the water in excess stagnates or start rilling and running off downslope conditioning the hydraulic vulnerability of downhill lands.

Permeability tests performed in laboratory have confirmed in situ evidences, producing the same results and showing low permeability values around 10^{-5} cm/s, rising to about 10^{-4} cm/s in soil samples slightly wet. The permeability variation undergone by the wetting red soils is due to the slow hydration and bulking of clay and iron minerals, that gradually tend to limit all inter-clastic voids and therefore reduce gravific water mobility. In particular, as the amount of swelling mineral is low, the role of ghoetite should be determinant, since it is an iron mineral characterized by a structure similar to clay minerals.

The overall set of tests performed within the present work has pointed out that as a function of initial water content, permeability of red soils may range from values that allow entirely absorption of quite intensive rainfalls (up to 20-50 mm/h) to values that make these soils nearly impermeable. The work carried out within this study pointed out how strongly the permeability of red soils is conditioned by the initial water content. Prolonged hydration of this soil causes a remarkable decrease of permeability and therefore rainfall infiltration becomes more difficult conditioning groundwater recharge and land hydraulic vulnerability.