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Is coastal landsliding in blue clays influenced by pore water composition? The case of NW coast of the Island of Malta

Borgatti L.[1], Cervi F.[1], Devoto S.[2], Princivalle F.[2], Scarpelli P.[1]

1 University of Bologna; 2 University of Trieste

Corresponding author details:
lisa.borgatti@unibo.it

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Abstract:
Geotechnical properties of clayey terrains are largely influenced by pore-fluid composition and concentration. In particular, the importance of shear strength and its variations for the evolution of landslides involving clay-rich terrains has been recognized in scientific literature, but the understanding of this issue has not been fully achieved yet and its quantification remains still difficult. This paper presents a comprehensive investigation involving chemical, mineralogical and geotechnical tests which were carried out on remolded soil samples from the Blue Clays Formation outcropping on the NW coast of Malta. This portion of Malta is affected by extensive landslides, such as rock spreads, block slides, earth slides and earth flows. The aim of the study is to assess whether the interaction of Blue Clays and related landslide deposits with marine water plays a role in the triggering and reactivation of slow-moving block slides occurring in the vicinity of the shoreline. In fact, groundwater mineralization at depth varies during the hydrological year and depends on rainfall recharge and on sea water intrusion processes. Four remolded samples were picked up at one-meter depth inside landslide deposits located on the northern part of Anchor Bay and in the western portion of Badjja Ridge. The samples were characterized from the mineralogical point on view with X-ray Diffractometry. Grain size distribution was obtained together with residual shear strength in a ring shear apparatus. The geological model of the coastal slopes has been implemented in a FE numerical model, including the rainfall infiltration process and the deformation analysis, with geotechnical properties changing with respect to different groundwater composition. The study highlighted that Na+ content in groundwater influences the geotechnical behavior of slope materials; this is due to the high fraction of active clays in the soil samples (up to 40% of Smectite). The outputs obtained by numerical models permit to recognize the role of water in the coastal evolution of NW Malta and assist geologists to assess landslide hazard of above-cited coast visited by thousands of tourists for its pristine beauty.