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Geotechnical and hydrological investigations into a landslide prone site at Rufiberg, Canton Schwyz, Switzerland

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Rufiberg (Canton Schwyz, Switzerland) is known to be prone to shallow landslide events. Situated on the opposing slope to the 1806 Goldau rock avalanche, the underlying bedrock includes dipping marls, sandstone and conglomerates from the Molasse deposits of the Alps, with a 1-2m cover of topsoil.
The monitoring site at Rufiberg is a collaboration between groups working at WSL, ETH Zürich, EPF Lausanne and University of Zürich. It aims to lead to a better understanding of the hydrological, hydrogeological and geotechnical processes that interact at Rufiberg to cause slope instabilities.
The site is situated on a slope of average 30° and was set up in 2009 in the form of a 40m x 60m fenced off field, at approximately 1200m asl. Hydrological surveying at Rufiberg began in 2009 with the installation of 4 clusters of TDR sensors, tipping bucket gauges and groundwater wells, in order to establish the behaviour of water flow through the soil. Six boreholes (11 cm in diameter) were drilled in November 2010 to depths of 2.2-9.15 m, all of which were instrumented subsequently with piezometers and water pressure sensors.
Soil characterisation at the site has shown that the topsoil is 1-2m in depth, and has an Ah (organic, OM) layer of approximately 20cm depth overlying an orange (CM) medium plasticity clay rich soil, and a highly gleyed grey (CM) medium plasticity clay. Samples were taken from a 1 m x 1 m trench dug in the centre of the monitoring site at intervals of every 40cm down to bedrock. Particle size distribution curves indicate a CM soil, with a 20-35% clay content (the majority of the remaining soil is made up of silt sized grains in all cases), and a PIasticity Index ranging from 15% (Liquid Limit (LL)= 38%, Plastic Limit (PL) = 23%) at the top of the profile to 26% (LL = 45%, PL = 20%) near the boundary with the bedrock.
Mercury Intrusion Porosimetry (MIP) and X Ray Diffraction (XRD) analysis have given indications of the microstructural and mineralogical state of the soil profile. MIP samples have shown a wide range of pore size distribution, with a modal pore size of 700 nm at the top of the soil profile, decreasing to 60 nm at a depth of 158 cm. XRD analysis has indicated that the dominant (up to 20 wt%) clay phase present at Rufiberg is Smectite: a clay mineral with high swelling potential.
Ongoing studies aim to understand the hydrological processes occurring at Rufiberg, along with the interactions between the clay mineralogy, porosity and permeability and other geotechnical parameters such as compressibility and strength. Geophysical techniques will be used to give a greater understanding of the subsurface structure of the soil and bedrock and how the state of the ground varies with infiltration, exfiltration and drainage.