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Monitoring and Analysis of Transient Pore Water Pressures in Large Suspended Rock Slides near Poschiavo, CH

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Many mountain slopes in the Alps exhibit large compound rock slides or Deep Seated Gravitational Slope Deformations. Due to the basal rupture plane geometry and the cumulative displacement magnitude such landslide bodies are often strongly deformed, highly fractured and – at least locally - very permeable. This can lead to high infiltration rates and low phreatic groundwater tables. This is also the situation in the studied mountain slopes southwest of Poschiavo, where large suspended rockslides occur, with very little surface runoff at high elevations, and torrents developing only at the elevation of the basal rupture planes. Below the landslide toes, at altitudes below ca. 1700 m a.s.l., groundwater appears forming spring lines or distributed spring clusters.

Within the scope of the design of a hydropower pump storage plant in the Poschiavo valley by Lagobianco SA (Repower AG), numerous cored and deep boreholes (of 50 to 300 m depth) have been drilled along the planned pressure tunnel alignement at elevations ranging from 963 to 2538 m a.s.l. in the years 2010 and 2012. In several boreholes Lugeon and transient pressure tests were executed and pore water pressure sensors installed in short monitoring sections at various depths. Most of these boreholes intersect deep rockslides in crystalline rocks and limestones, showing highly fragmented rock masses and cohesionless cataclastic shear zones of several tens of meters thickness.

This study explores these borehole observations in landslides and adjacent stable slopes and links them to the general hydrologic and hydrogeologic framework. The analysis of the pore water pressure data shows significant variability in seasonal trends and short-term events (from snow melt and summer rain storms) and remarkable pressure differences over short horizontal and vertical distances. This reflects rock mass damage within landslide bodies and important sealing horizons at their base. Based on water balances, the estimated effective infiltration rate at higher slope elevations (dominated by landslide bodies) is in the order of 300 mm per year.

Quantitative analyses of recharge, piezometric levels and hydraulic conductivities are supported by larger scale 2D groundwater flow modeling under steady state and transient conditions. Preliminary results support the hypothesis of efficient hydraulic barriers at the base of large rockslides and effective hydraulic conductivities of damaged rockslide bodies of about 10^{-6} m/s.