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Geological investigation and movement analysis of the deep-seated compound rockslide Laatsch, South Tyrol

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In Alpine areas, deep-seated rockslides are relatively common. They are mostly based on geological and tectonic conditions and triggered by permafrost degradation, snowmelt or heavy rainfall events. A striking example is situated near Laatsch, South Tyrol, at the valley entrance of the Münstertal at close range to the national road SS41 leading to the Swiss border. The activation of the movement occurred in the year 2000, showing a rapid expansion since the year 2012 causing a relocation of the road in 2014.

The U-shaped valley of the Münstertal was formed by glaciers, the valley floor is filled with alluvial sediments. The Mountain ridge runs approx. 2,100 m above the Adriatic Sea, valley floor at approx. 1,000 m above Adriatic Sea. The slope gradient varies between 30 and 50°. The rockslide situated in this slope is approx. 400 m wide, approx. 700 m in height at its longest extension, with a slide surface ca. 50 - 100 m deep summing up to an instable rock volume of approximately 5 to 10 million m³ and monthly average movement rates of 0.1 to 0.55 m.

Geological mapping and analysis were performed for the detailed identification of the cause of failure and occurring failure types such as sliding, falling, toppling and flow. The different gneiss bedrock types mainly consist of Quartz, Feldspar, Muscovite and Calcite, foliation is mainly caused by Muscovite layers. Muscovite-rich shearing planes could also be identified via thin section analysis. The foliation dips with a dip of ca. 10-20° mainly towards Northeast and therefore is orientated towards the slope. Two sets of very steep dipping joins are present deeply fragmenting the rock mass providing starting points or lines for the development of scarp surfaces. Deep weathering of the disintegrated gneiss bed rock could be observed at tectonically induced fracture surfaces. Weathering progresses along scarps and developed tension cracks further eroding and dissembling the rock mass.

Movement analysis of different slabs were performed twice a year using multi-temporal terrestrial laser scanning (TLS) between 2017 and 2020. Along this sliding surface, rock material is transported as individual slabs showing mainly a translational movement behavior with minor internal deformation. These slabs are visually recognizable on site as well as during the analysis of movement rates of laserscanning series measurements. Main mass transport occurs from upper steep slope areas to areas of lower slope angle within and at the foot of the rockslide. General movement occurs via a basal slip surface with an average thickness of failure volume of approx. 50

to 100 Meters.

Volume of displaced material during accompanied processes of rock fall and rock topple events amounts to 2,000 - 5,000 m³ depending on the size of the event. These types of rock movement mainly take place along outbreak recesses at the rockslide flanks, scarps and at the internal slab margins. These falls and topples can also be detected through several laserscanning measurement series.