GEOLOGICAL CHARACTERISTICS OF THE FERNPASS ROCK AVALANCHE DEPOSITS (TYROL, AUSTRIA)

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The Fernpass-rockslide mobilised about 1000Mm^3 of carbonate rock-debris (Seefeld-Fm., U-Triassic), which accumulated as thick proximal ridge and two rock-avalanche (RA) branches discharging thereof. One branch travelled slightly deflected for at least 10.8km (to the NE), and another, mechanically less coherent, for at least 15.5km (to the SW). It is the first landslide dated applying three different radiometric methods to individual sampling-sites: i) ^{14}C-dating (rockslide-dammed torrent-deposits), ii) cosmogenic ^{36}Cl exposure-dating (sliding-planes at the scarp and accumulated rockslide-boulders), and iii) U/Th-dating (aragonite-cements precipitated in the RA-deposits). These data consistently indicate one failure-event at approx. 4.2 ka. Thus, the extraordinary run-out was not favoured by a contact with glacier-ice, but by a combination of: i) enormous volume, ii) penetrative dynamic rock-mass fragmentation, iii) channelling-effects in the narrow valleys, iv) undrained loading of valley-sediments. This was validated by a variety of geological and geophysical field-investigations.

Hybrid seismic measurements in the proximal accumulation-area depict a parabolic valley cross-section underneath the present-day Fernpass. This and the spatial extent of the scarp-niche indicate a steep some 100m high paleo-slope (thus evidence of a fault-related valley-deepening) and hundreds of metres thick engineering soils. Concerning the proximal RA-deposits, diving-wave tomography yielded varying seismic velocities, pointing to different lithologies and/or inhomogeneous degrees of fragmentation (slabs/blocks, finer matrix). Based on the field data compiled, the curiously deflected southern RA-branch originated from a gravitational collapse of the several 100m thick debris-ridge which makes up the proximal accumulation-area (i.e. Fernpass-apex).

The mechanical behaviour of the Fernpass RA was characterised by laminar flow-processes (indicated e.g. by Pleistocene cover-rocks transported piggy-back atop the failing debris from the source), and transversal extensions. These extensions and gravitational spreading produced distinct graben and ridge structures (medial areas, some filled with kettle-like lakes) as well as the cone-shaped Toma-hills (distal areas). Ground-penetrating-radar investigations and drillings indicate that the medial to distal RA-deposits spread upon fine groundwater-saturated substrata.

Regarding geotechnical properties, the RA-deposits appear as BIM-rocks, i.e. heterogeneous mixtures of rock-fragments of various sizes embedded in a finer matrix. The grain-size distributions, along with lithological parameters and in-situ-densities, control the hydrogeological characteristics, e.g. springs with high discharge-rates and others featuring radioactive emanations (cf. U/Th-dated cements).