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Thickness and internal structure of relict rock glaciers – a challenge for geophysics: Examples from two rock glaciers in the Eastern Alps

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Knowledge of thickness and internal structure of relict rock glaciers is generally sparse but key factors for their storage capacity and thus their impact on the alpine water cycle. In this study we present results of geophysical measurements carried out at two neighboring rock glaciers located in the Seckauer Tauern Range, Austria. Both rock glaciers have been considered originally as relict. The Schöneben Rock Glacier (SRG) is a monomorphic rock glacier covering an area of 0.11km^2, has a length of 750 m, a width of up to 200 m and ranges from 1720-1905 m a.s.l. The Reichart Rock Glacier (RRG) is a large polymorphic rock glacier with two main source areas covering an area of 1.26 km^2, and ranges from 1520-1920 m a.s.l.. The landform has a length of 1860 m and a maximum width of c.1600 m. Both rock glaciers consist predominantly of coarse-grained, blocky gneissic sediments at the surface. At SRG ground penetrating radar (GPR) and seismic refraction (SR) was applied thereby profiling the entire rock glacier. GPR was carried out at ten profiles (two longitudinal profiles and eight cross profiles) with a total length of 3235 m. SR was applied at three profiles (one longitudinal profile and two cross profiles) with a total length of 1259 m. Seismic energy was generated by using a sledge hammer as well as blastings near the surface. At RRG electrical resistivity tomography (ERT) and SR has been applied. One 340 m long SR cross profile was accomplished close to the rock glacier front. Furthermore, one 120 m long ERT longitudinal profile was measured starting from the upper part of the rooting zone of RRG and ending within the talus slope above the rock glacier. Generally SR data clearly indicate the boundary between sediments and bedrock for both rock glaciers. Seismic P-wave velocities range between 550 and 900 m/s for the near-surface debris layer, between 1370 and 1880 m/s for deeper sediments layers (possibly due water saturated, fine-grained sediments), and between 3900 and 4100 m/s for bedrock. At the altogether eleven ERT profiles rock glacier thicknesses vary between some meters to several tens of meters. GPR results indicate complex subsurface structures with non-surface-parallel layering suggesting a complex sedimentology related to former creep processes. The ERT profile at RRG revealed sporadic occurrence of permafrost. At the measured profile an active layer of 2 to 4 m is underlain by a permafrost body along 3/4 of the entire profile with resistivity values between 50-100 kOhm.m and extending to a depth of 10 to 15 m. Therefore the RRG might be regarded as a pseudo-relict rock glacier which looks superficially relict but contains locally isolated patches of permafrost at the rooting zone. For the SRG this question cannot get answered with the presently available geophysical data. In summary, the chosen geophysical methods helped to get insights into the two rock glaciers although interpretation of the measurement results is frequently difficult.