

Spatial distribution of rock glaciers in the semi-arid Andes of Argentina

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Active rock glaciers are indicators for permafrost in periglacial environments of high mountain areas. Within the permafrost body and the seasonally frozen active layer, these rock glaciers potentially store large amounts of water. Especially in semiarid mountain belts, such as the central Andes of Argentina, rock glaciers attain several kilometres in length, covering surface areas of >106 m². Here, rock glaciers even outrange ice glaciers in cumulative area and absolute number, indicating they might constitute a large water reservoir in this semiarid part of the Andes. Despite their potential hydrological importance, our knowledge about the rock glaciers' spatial distribution, subsurface composition and absolute ice content is still very limited.

Our study addresses this shortcoming and aims at assessing the hydrological significance of rock glacier permafrost in the semi-arid Andes of Argentina by combining local geophysical investigations with regional remote sensing analysis. Our research focuses on the central Andes between 30°S and 33°S, where we have compiled an inventory that comprises more than 1200 rock glaciers, as well as 154 clear-ice and debris-covered glaciers. Two field sites that bracket this regional study area towards their northern and southern edge have been selected for local geophysical investigations. At these locations, earlier studies detected the presence of rock glacier permafrost by thermal monitoring and geophysical prospection.

Preliminary results of the regional spatial distribution indicate that the spatial density of rock glaciers increases towards the south, concomitant with a twofold increase in mean annual precipitation. Rock glacier density peaks in the area of the Aconcagua massif, while precipitation is further increasing towards the south. Simultaneously, the lower altitudinal limit of intact rock glaciers slightly decreases, with the lowest rock glacier toe positions in the northern study area located at ~3800 m a. s. l., while in the Aconcagua massif, toe positions reach down to ~3500 m a.s.l. Furthermore, intact rock glaciers (309 km²) cover significantly more surface areas than ice glaciers (240 km²), and as debris-covered glaciers (104 km²), indicating their potential importance as water storage bodies.

In future, we aim at better determining the ice contents of central Andean rock-glacier permafrost, by combining electrical resistivity tomography (ERT), refraction seismic tomography (RST), and ground penetrating radar (GPR) in four-phase modelling. These geophysical investigations will be augmented by repeated UAV-surveys in order to assess rock glacier activity and volumetric gain or loss.