Glacial and Periglacial Evolution of the Mulhacen Cirque (Sierra Nevada, Southern Iberian Peninsula)

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Abstract

Semiarid Mediterranean mountains are in general very sensitive to global climate warming in terms of deglaciation and permafrost degradation. In the context of the PACE-Project (Permafrost and Climate in Europe) the aim of the undertaken research is to gain a better understanding of late Pleistocene and Holocene glacial and periglacial history of Sierra Nevada, the southernmost European range with subrecent glacial features and recent permafrost. Furthermore, this paper is focused on the complex relationship between the deglaciation and the subsequent expansion of periglacial processes in the Mulhacen cirque.

Detailed morphological mapping on a scale of 1:5000 and morphometrical analysis of glacial and periglacial deposits along several cross sections were carried out in the Mulhacen cirque situated at an altitude between 2863 m (lowest area of the cirque bottom) and 3478 m a.s.l. (highest point of the headwall). High-resolution geophysical surveys were undertaken close to the Mulhacen peak.

According to the obtained geomorphological data up to five principal moraine complexes at different altitudes (2863 – 2940 m a.s.l.) were identified. Based on morphological criteria, E.L.A. calculations and correlation with the glacial records or the Veleta cirque we propose a late glacial age for the different moraine stands. The small differences in altitude and geographical distribution of the end moraine arches indicate the high sensibility of the glacier to past climate changes. However, the Mulhacen cirque and the Valdecasillas valley offer one of the most complex moraine sequences in southern Iberian Peninsula.

With regard to the periglacial dynamics rockfalls, debris flows, rock glaciers, protalus rampart, block fields, stone rivers and gelifluction lobes were identified and mapped. In the southwestern sector of the cirque the youngest moraine is nearly completely buried by younger rockglaciers and rock streams indicating the high efficiency of the periglacial processes during the Holocene. These processes are mostly controlled by the Holocene climatic conditions (cycles of freezing and thawing), topographical configuration and fragility of the outcropping schist related also to the postglacial release of the cirque headwall. Resistivity tomography data obtained from the southern slope of the Mulhacen peak may evidence discontinues permafrost.