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Bottom temperature of snow and its geomorphologic significance in Mediterranean mountains (Sierra de Guadarrama, Spain)

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Sierra de Guadarrama is located in the center of the Iberian Peninsula, 70 km from the city of Madrid. The highest peak in the range is Peñalara (40ž51'N, 3ž57'W) with an altitude of 2428 m. The detailed study of the geomorphologic processes in the summit areas of the Guadarrama mountains revealed that nival niches at elevations from 2100 to 2300 m always face east and are downwind of snow storms from the west. These niches are active if snow duration exceeds 210 days/yr and the granitic and gneissic rocks that form the Sierra show evidence of intense weathering (Andrés and Palacios 2004; Marcos and Palacios, 2004, Palacios, Andrés and Luengo, 2003).

In order to identify the nature of the erosion process taking place in the niches and to determine whether it was mainly mechanical or chemical, the study examined the thermal regimes for ground temperature and bottom snow temperature for five years at two nival niches (Dos Hermanas 40ž50'9''N and 3ž57''52''W; Condesa (40ž47'6''N and 3ž58''39''W) in Sierra de Guadarrama. Automatic thermal probes were planted in the study areas to record air temperature, ground surface temperature, and subsurface temperatures at depths of 10 cm and 80 cm. In addition, boreholes were made in the snow each month to determine temperature and density at different depths. The probes were located at several sites inside and outside the niches and provided data on snow depth and duration.

The results indicate that at snow depths $>$ 20 cm, variations in air temperature affect neither ground surface nor the subsurface at a depth of 10 cm. The bottom temperature

of the snow remained stable at about -0.5 žC, inside the niches, and at a depth of 10 cm, it stayed at +0.5 žC at the start of the snow season and dropped very slowly to below 0 žC at the end of the season, shortly before the thaw. The temperature at a depth of 80 cm inside the niches was always positive, and the ground was always waterlogged. These results may indicate that chemical weathering rather than periglacial action is predominant inside the nival niches. Observations in non-snow covered areas revealed more than 100 freeze-thaw cycles every year, while only one cycle was detected in areas with deep snow cover.

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