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Solution Dynamics at the Rock/Snow Interface during Ablation Period in Subnival Karst of Wetterstein Mountains (Northern Calcareous Alps, Germany)

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Abstract
The study focuses on limestone solution under snow (mean maximum depth: 450cm) in the subnival zone (2350 to 2600 m) of Wetterstein Mountains (47°24'N; 11°7'E). The analysis of melt water discharge out of two lysimeters (bare and debris-filled) at the rock/snow interface concentrates on carbon dioxide, defining water acidity. Diurnal records reveal low values of CO_2 and the synchronization of these amounts to runoff until stored CO_2 is depleted. Hourly data indicate that cold interface waters have only one fourth of the dissolution capacity of fresh superficial snow (mean: 4.5 mg • l-1 CO_2). Mostly homothermal cold conditions at the base justify the supply of atmospheric CO_2 by percolating waters top down. Gas detector measurements, revealing a decrease of CO_2 with depth caused by increasing snow density, illuminate the control of snow properties also on CO_2 diffusion. Minimum amounts (0.005 vol.-%) at 300 cm depth, quadrupling near the surface, prove an insufficient supply of CO_2, causing low mean dissolution rates of debris. This almost closed system changes with strong snow cover reduction in July. Then, higher CO_2 values demonstrate enhanced atmospheric interaction, accelerating solution until the maximum of 28 mg • l-1 $CaCO_3$. Seasonal solution intensity due to CO_2-trigged water acidity interacting with high melt water budgets explains subnival karst.