Quantifying Variations of SWE, Chemistry, and Water Isotopes in a Montane Snowpack: Valles Caldera National Preserve, NM

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This study quantifies how vegetation, aspect, and storm track control spatial and temporal patterns in snow chemistry and water isotopes. This research is one of three simultaneous projects designed to identify how vegetation and topography control spatial and temporal patterns of snow water input to a characteristic southwestern U.S. mountain catchment.

We collected depth, density, stratigraphy, temperature, and snow chemistry samples from five snow pit locations on approximate monthly intervals between January and April 2007. Snow pit locations were established varying aspect and vegetation density independent of elevation. Snow samples were analyzed for major anions (Cl^-, NO_3^-, SO_4^{2-}), major cations (Ca^{2+}, Na^+, K^+), water isotopes, and biogeochemical nutrients (DOC, DN). Snow water equivalent (SWE) varied by 45% (187 - 340mm), SO_4 by 22% (10.6 - 13.5 μeq/L) and $\delta^{18}O$ by 17% ($^-$16.3 - $^-$13.5‰), with SWE exhibiting an inverse correlation with both SO_4 ($r^2 = 0.75$) and $\delta^{18}O$ ($r^2 = 0.96$). The relationships between snowpack δD vs. $\delta^{18}O$ suggest these patterns resulted from snowpack sublimation rather than deposition. Using conservative tracer water balance equations, sublimation is estimated to range from -3.8% to 18.3% of the snowpack water budget. A precipitation lapse rate based on nearby meteorological stations suggests these estimates are low and may be convoluted by atmospheric water vapor interactions