Seasonal Groundwater Recharge in the Snow-Dominated Sierra Nevada using Cosmogenic S-35

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Identifying aquifer vulnerability to climate change is of vital importance in the Sierra Nevada and other snow-dominated basins where groundwater systems are essential to water supply and ecosystem health. Determining groundwater recharge and storage on short (<1 year) timescales is useful in evaluating aquifer vulnerability because significant discharge of new (<1 year old) snowmelt from the basin may indicate shallow groundwater reservoirs with a low buffering capacity in response to climate change. The goal of this study was to utilize the naturally-occurring cosmogenic isotope sulfur-35 (S-35) to quantify seasonal snowmelt contribution to groundwater and surface waters in Sagehen Creek Basin (SCB) and Martis Valley Groundwater Basin (MVGB), two adjacent basins located in the central Sierra Nevada, California. Activities of S-35 were measured in dissolved sulfate in SCB and MVGB snowpack, groundwater, and streamflow. The fraction of new snowmelt (FNS) in SCB groundwater and streamflow was determined using the average winter snowpack S-35 activity as the precipitation end member. An expansion of this study in MVGB involved more frequent snow sampling with the end member defined as the volume-weighted mean S-35 activity in snowpack. The FNS in SCB streamflow ranged from <6% during baseflow conditions to 22% during high flow periods. Similar to SCB, the FNS in MVGB groundwater and streamflow was typically <26% with the largest fractions occurring in late spring or early summer following peak streamflow. The consistently low FNS suggests that a significant fraction of seasonal snowmelt in SCB and MVGB recharges groundwater, and that groundwater contributions to streamflow in these systems has the potential to buffer climate change impacts on runoff.