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№ 26033

DETERMINATION OF RECHARGE SOURCE AREAS AND GROUNDWATER RESIDENCE TIMES IN FRACTURED BEDROCK USING STABLE OXYGEN ISOTOPES

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In order to constrain the travel paths and rates of groundwater flow in a Vermont upland basin, specifically the fractured schist aquifer of the upper Browns River in Northwestern Vermont, we are investigating the temporal trends in the stable oxygen isotope composition of precipitation and groundwater. Rain samples have been collected since July of 1995 on a weekly basis at 16 stations in the study area which includes the slopes and summit of Mount Mansfield, elev. 1440m MSL. Snow and snowmelt samples were collected through the snow season (November - April) at 5 of these locations. Groundwater is sampled weekly from residential wells at 8 locations. Laboratory analysis of $\delta^{18}O$ for over 600 samples provides time records of the variation in oxygen isotopic composition of precipitation and groundwater throughout the basin.

At each station we observe a seasonal variation,with an amplitude of 18 to 25‰, in the $\delta^{18}O$ values of precipitation. This variability is predominantly caused by seasonal temperature changes. Differences in average temperatures between the low and high areas of the basin also create an altitudinal gradient in the mean $\delta^{18}O$ values of precipitation of approximately -2.3‰/1000 meters elevation. Analyses of groundwater samples indicate that the $\delta^{18}O$ signature of groundwater exhibits a seasonal pattern similar to that observed in precipitation, although of lesser magnitude (1.0 to 4.7‰). This suggests that the isotopic composition of groundwater is controlled by seasonal variations of the isotopic composition of infiltrating recharge waters. We suspect that the smaller amplitude of variation observed in the groundwater $\delta^{18}O$ records reflects mixing in the fractured bedrock aquifer.

The $\delta^{18}O$ records for precipitation and groundwater provide initial estimates of the recharge elevation for each well. Combined with knowledge of the aquifer's structural properties, additional geochemical data (major and trace elements), as well as age determination (^{3}H, ^{36}Cl) of selected groundwater samples, this information is being used to determine the residence time of groundwater within the basin.

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groundwater, bedrock aquifer, stable isotopes, residence time, recharge

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2155