Geophysical Research Abstracts, Vol. 7, 02927, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02927

Variability in stable oxygen and hydrogen isotopes of precipitation in a mountain watershed, Turkey Creek Basin, Jefferson County, Colorado, USA

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Turkey Creek Basin (TCB) is a mountain watershed that covers approximately 122,000 square kilometers and ranges from 1800 to 3350 meters elevation. The watershed is located about 30 kilometers from Denver. Individual water wells and sewage disposal systems support a population of approximately 12,000 people living within the basin. The aquifer is present within fractured, heterogeneous Proterozoic crystalline basement rocks. The Colorado Front Range experiences a semi-arid climate, with a mean annual precipitation of about 50 cm. Increasing population pressure and close proximity to a major metropolitan setting has led to several assessments of the hydrology of the watershed.

We have initiated a sampling program that focuses on the stable oxygen and hydrogen isotopes of atmospheric precipitation and groundwater wells collected from stations within and around the watershed. Models for estimation of groundwater recharge using these stable isotopes have been successfully applied elsewhere by quantifying and correlating groundwater isotopic composition with that of annually variable precipitation composition. Samples from the TCB collected for all precipitation events and analyzed from August 2004 to January 2005 fall along a defined meteoric water line with slope of 7.6 and a deuterium excess (deficit) of -6.4. Both slope and deuterium excess values vary by storm and by location in the basin (slope from 7.1 to 8.5, and deuterium excess from -14.8 to 6.6), and they positively co-vary (r^2=0.87). Overall, storms occurring within this five-month period show a range in δ^{18}O from -2 to -24 per mille VSMOW and in δD from -24 to -217 per mille VSMOW. Extreme isotopic variability in precipitation in the TCB relates in part to multiple moisture sources de-

livered to the Colorado Front Range, including moisture delivered by the Polar Jet Stream, the Subtropical Jet Stream, the Gulf of Mexico, and local convective redistribution.

Variation in groundwater isotope compositions during the same period is strongly attenuated relative to the precipitation, with δ^{18}O ranging from -15 to -9 per mille VSMOW and δD ranging from -120 to -80 per mille VSMOW. The groundwater compositions are approximately in the midrange of precipitation values, suggesting either that recharge is associated with storms that possess these limited compositions or, more likely, that recharge represents a mixture of waters sourced throughout the annual cycle.