April 21, 2008, Hydrology Seminar, New Mexico Tech

Isotope and Aqueous Chemistry Investigations of Groundwater in the Española Basin, New Mexico

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Determining groundwater ages and flow paths within aquifer systems is essential for calibrating flow and transport models and designing and implementing effective monitoring systems. The Los Alamos National Laboratory and New Mexico Environment Department have conducted several isotope and geochemical investigations from October 2004 to present. The investigations evaluate groundwater flow paths and ages and aqueous chemistry of samples collected from perched alluvial and intermediate zones and from the upper portion of the regional aquifer beneath the eastern Jemez Mountains (Sierra de los Valles) and the Pajarito Plateau, New Mexico. Water samples were analyzed for tritium, carbon-14, noble gases (helium-3, helium-4, and neon-22), stable isotopes of carbon, hydrogen, and oxygen, and inorganic solutes consisting of major ions, trace elements, and trace metals. Alluvial groundwater is entirely modern (recharged after 1943) based on the tritium/helium-3 dating method. Perched intermediate-depth groundwater, ranging in depths up to 600 feet, within the Sierra de los Valles and beneath the Pajarito Plateau, is either entirely modern or a mixture of modern and sub-modern (recharged prior to 1943) components. The regional aquifer is either sub-modern or mixed in age. Unadjusted ^{14}C ages for the regional aquifer vary from 600 years before present (BP) beneath the western portion of the Pajarito Plateau to a range of 2,100 to 9,700 years BP at White Rock Canyon springs that discharge west of and along the Rio Grande. Ground-water ages greater than 8000 years BP measured for supply wells are associated with longer and deeper flow paths associated with longer residence times. The modern ages obtained for the majority of the Sierra de los Valles springs imply that most are sustained by local infiltration. The close similarity in stable isotope ratios between shallow regional wells on the Pajarito Plateau and some of the White Rock Canyon springs and presence of anthropogenic tracers suggest that the springs discharge groundwater from the uppermost portion of the regional aquifer. Perched intermediate zones beneath the Pajarito Plateau also are connected to several of the White Rock Canyon springs. The occurrence of modern recharge beneath wet canyons that dissect the Pajarito Plateau is supported by occurrence of anthropogenic tritium, nitrate, uranium, chromium(VI) and/or perchlorate in both intermediate perched zones and the regional aquifer. For example, tritium released into Mortandad Canyon in 1963 has reached the regional water table within 25 years based on ages of the modern component. Binary mixing of alluvial and regional aquifer groundwater beneath several watersheds is revealed by chloride concentrations. Distributions of chromium and uranium in the subsurface point to both natural and anthropogenic sources.