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Forensic Isotope Hydrology as a Support to Complex Water Issues in the Arid Southwestern US

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ABSTRACT

Water resources in the arid southwest are frequently the subject of arbitration between competing interests of private and public entities. Although the legal remedies allow for a path forward, the technical nature of the problem often determines the future success of any solution. The term technical used here encompasses: 1) the hydrogeological properties of water quantity, availability, distribution, and 2) the geochemical issues of water quality, transport and migration, contamination, or mixing with lower quality reservoirs. These examples of multi-use issues change over time and could negatively impact another water user or natural resource. One successful approach can be the inclusion of all agencies early in the technical evaluations from data collection to interpretation, and in addition, to include private sector firms with state of the art investigative techniques. In Owens Valley, California the source of water for the Los Angeles Aqueduct (LAA) is flow diverted from the Owens River and its tributaries, as well as pumping from well fields. Future management of groundwater delivered to the LAA needs technical support regarding quantity available, interconnection of shallow and confined aquifers, impact on local springs, and rate of recharge. Ground water flow models and ground water composition are baseline tools already in use, but have large uncertainty. Corroboration of conceptual and numerical models can be provided by geochemical investigation of the evolution of composition along flowpath and measurement of intrinsic isotopic composition at key locations in the aquifers. This joint technical research team relied on existing flow simulation augmented with targeted sampling of chemical and isotopic components to evaluate the hydrologic system. The stable isotopic data of boron ($\delta^{11}B$), sulfur ($\delta^{34}S$), oxygen ($\delta^{18}O$), hydrogen (δD) as well as tritium (^{3}H) supported by basic chemical data, confirmed the interpretation of groundwater flow near faults and flow barriers, identified zones of preferential flow, allowed for an assessment of interconnection between a shallow unconfined and deep confined aquifer, and detected hydraulic connections between the LAA and perennial springs at key locations along the unlined reach of the aqueduct. In this investigation success is being defined as a joint technical task of affected parties cooperating in the project from data collection to reporting. The geochemical results yielded an independent check on consistency of interpretations of the groundwater system from, conceptual and numerical hydrologic simulations.

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