Springs and associated riparian environments provide critical habitats for both aquatic and terrestrial wildlife in the Grand Canyon region. Springs also provide drinking water for Grand Canyon National Park (GCNP). Grand Canyon springs are fed by world-class karst aquifer systems (both shallow and deep) on the Colorado Plateau, but increasing pressure on groundwater resources from climate change, mining and other development activities pose major challenges to resource managers. The shallow and deep karst systems of the region interact in ways that are revealed by recent studies. General hydrologic models for the Colorado Plateau aquifers highlight the importance of recharge areas (‘springsheds’) for water supply. Ongoing work by several groups is helping to understand these complex relationships using multiple tracer methods. A robust monitoring and geochemical sampling program can provide data for understanding the sustainability of spring-fed water supplies for anthropogenic use. Our ongoing geochemical studies of spring waters (including dissolved gases) have identified the importance of mantle-derived volatiles and CO2 that contribute dissolved salts and other products of water-rock interactions at depth to the regional aquifer systems. Faults are important conduits for fluid transport and mixing and hence impart a tectonic influence on water quality. The result is a multi-porosity system resulting from variable ages and mixing of meteoric recharge, karst system transport, matrix sandstone transport, fault connectivity, and endogenic inputs. Quantitative forecasting of the effects of climate change on water quality depends on our understanding of these deep inputs (diminishing surface flows affecting recharge rates), as well as aquifer recharge flowpaths and quantities. Results from Grand Canyon and other spring-supported stream systems in the western U.S. indicate the need for development of hydrologic baselines that recognize these complexities. This can be accomplished through use of both natural and artificial tracers to unravel mixing and environmental sensors to monitor real time changes. These investments are needed to inform water management decisions that address societal and ecosystem needs.

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