# Determining water and carbon fluxes into groundwater from a semiarid floodplain vadose zone

TETSU K. TOKUNAGA[1]*, JIAMIN WAN[1], WENMING DONG[1], KENNETH H. WILLIAMS[1], MARK J. ROBBINS[1], YONGMAN KIM[1], BORIS FAYBISHENKO[1], MARK E. CONRAD[1], JOHN N. CHRISTENSEN[1], CHAD HOBSON[1], BENJAMIN GILBERT[1], RICHARD D. DAYVAULT[2], PHILIP E. LONG[1] AND SUSAN S. HUBBARD[1]

[1]Lawrence Berkeley National Laboratory, Berkeley, CA 94720 USA (*correspondence: tktokunaga@lbl.gov)
[2]S.M. Stoller Corporation, Grand Junction, CO 94025 USA

Water and carbon fluxes from the vadose zone into groundwater need to be quantified to understand subsurface hydrobiogeochemical conditions and predict impacts of climate change. These fluxes are challenging to determine in semi-arid regions because of their low magnitudes. However, the remediated uranium/vanadium mill tailings site on the Rifle, Colorado floodpain possesses characteristics favorable for investigating subsurface transport, includinglocally derived fill soil with geochemical characteristics typical of the region, an established vegetation cover, geochemically distinct boundaries between the fill and underlying alluvium, predictable groundwater interaction with the adjacent Colorado River, and an impermeable lower boundary (shale at ~7 m depth). Within this well-defined hydrological system, we installed neutron probe access tubes and depth-distributed tensiometers, pore water samplers, and gas samplers along a transect aligned with the groundwater flow direction in order to determine inventories and fluxes of water, carbon, and other components. Seasonally dependent recharge into groundwater is quantified by combining field measurements with laboratory/pedotransfer constraints on hydraulic properties. High dissolved organic carbon (DOC) concentrations in the vadose zone (up to ~10 mM) relative to in groundwater (<1 mM), and increasing $CO_2$ concentrations with depth indicate the importance of deeper vadose zone OC transport and microbial activity. DOC characteristics and trends are being used to improve understanding of vadose zone fluxes of carbon into groundwater. Variations in carbon availability and water saturations at the capillary fringe are also reflected in changes to redox-dependent chemical components, including residual U and V. This effort is part of Sustainable Systems 2.0, a new Department of Energy project investigating climate-induced changes in subsurface carbon transport, biogeochemical transformations, and metabolic potential of microbial communities.