Physical and Chemical Characterization of Vadose Zone Below Almond Orchards

Project Leader: Peter Nico
Lawrence Berkeley National Laboratory, One Cyclotron Road, M/S 74R316C, Berkeley, CA 94720
(510-486-7118), psnico@lbl.gov

PROJECT SUMMARY

Objectives:

- Use geophysical imaging technologies to understand the subsurface structure below a groundwater recharge test site
- Use Isotopic tracers to track infiltration of applied excess water
- Incorporate the results from the previous objectives into a geochemical model

Background and Discussion:

The goal of this project is to extend our understanding of the process of water infiltration for ground water recharge into the "vadose zone," the unsaturated soil and sediments below the root zone and above the aquifer. To sustainably effectively manage water recharge, it is important to understand the physical and chemical complexity (heterogeneity) of the sediments in the vadose zone. In the California Central Valley, this zone can range from tens to hundreds of feet in thickness. Materials in this zone are arranged in discontinuous layers laid down over geological time and may have little or nothing in common with the characteristics of the surface soils.

Results from this year include geophysical imaging at two test orchards, one near Modesto and one near Delhi. Both sites were characterized in October 2016 before significant precipitation to provide a baseline assessment of the below ground sediment structure during dry season conditions. The surveys revealed significant contrasting sediment types and large features that might be particularly important for conducting water into the subsurface. Both sites were imaged again in January 2017 before, during, and after a flooding event. Time lapse imaging of changes in moisture content showed very heterogeneous water movement and confirmed that large, sandier features in the subsurface likely had a particularly important role in allowing water to infiltrate below the root zone.

An isotope tracer experiment was also conducted during the winter flooding event. Deuterated water (D_2O) was applied to an approximately 10 sq ft area of soil between two trees before the flooding event and the movement of the deuterium isotope was measured over time. The results indicated only minor downward movement of the tracer, in spite of multiple inches of water being applied to the orchard and completely infiltrating.

Both the imaging and isotope tracer results emphasize the importance of particular vadose zone sediments being disproportionally important for conducting water into the ground, also known as fast flow paths. The presence of these fast flow paths has several implications including the potential to identify locations within a given orchard that allow for fast infiltration of applied water thereby reducing the overall footprint needed for recharge activities. It also has implications for the risks of transport of nitrate or salts into the underlying aquifer. These possibilities are being further explored using computer models developed based on the results discussed above.

Project Cooperators and Personnel:
Helen Dahlke, UC Davis, David Doll, UCCE=Merced; Roger Duncan, UCCE-Stanislaus; Nick Blom, Arnold Farms; Greg Newman, LBNL; Mark Conrad, LBNL, Craig Ulrich, LBNL; Yuxin Wu, LBNL

For More Details, Visit

- Poster location 37, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2017) at Almonds.com/ResearchDatabase
- Related Projects: 17-PREC9-Volder/Shackel; 17-WATER7-Horwarth/Dahlke; Poster 38 - Mountjoy