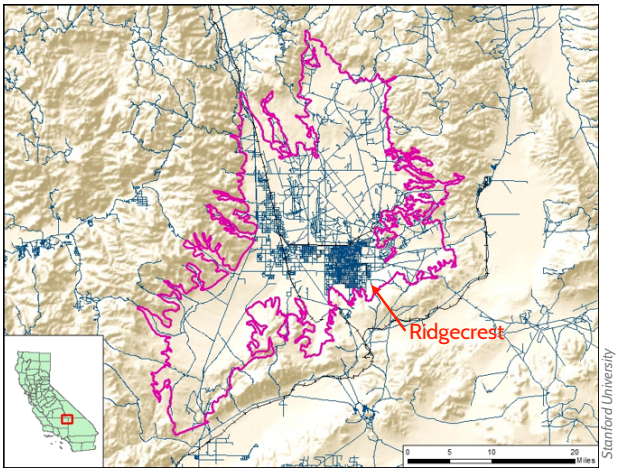
VISTACLARA INC.
NMR GEOPHYSICS

Case Study
Sustainable Groundwater Management

Motivation

The Indian Wells Valley in the Mojave Desert of California is home to the China Lake Naval Air Warfare Station, the city of Ridgecrest, and significant agricultural and mining interests. Residents and industries in the valley depend on groundwater, which has been depleted due to overuse since the 1960s.



The Indian Wells Valley Groundwater Authority required accurate information on the distribution and hydrologic properties of aquifers in the valley in order to sustainably manage these economically critical resources. The IWVDA contracted Stanford University to demonstrate the capabilities of surface and borehole geophysics as a cost-effective means to provide data for digital aquifer models of the valley.

Technical Approach

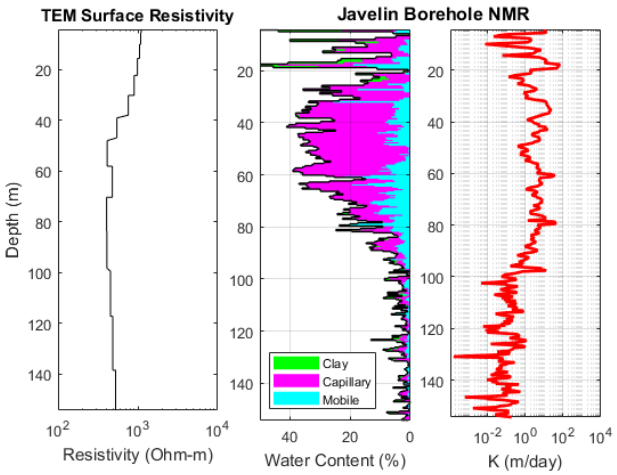
The Stanford team used a combination of NMR well logging, surface NMR and ground-based TEM to image hydrological properties and lithology across the basin. NMR logging measurements were acquired using a 3.5 inch Javelin® NMR logging tool in existing 4-inch and 6-inch PVC-cased monitoring wells distributed throughout the valley. Surface NMR measurements were performed using the GMR instrument. The surface and logging NMR measurements directly measured water content, pore size distributions and estimated permeability, while co-located TEM measurements provided ancillary information on lithology and groundwater quality.

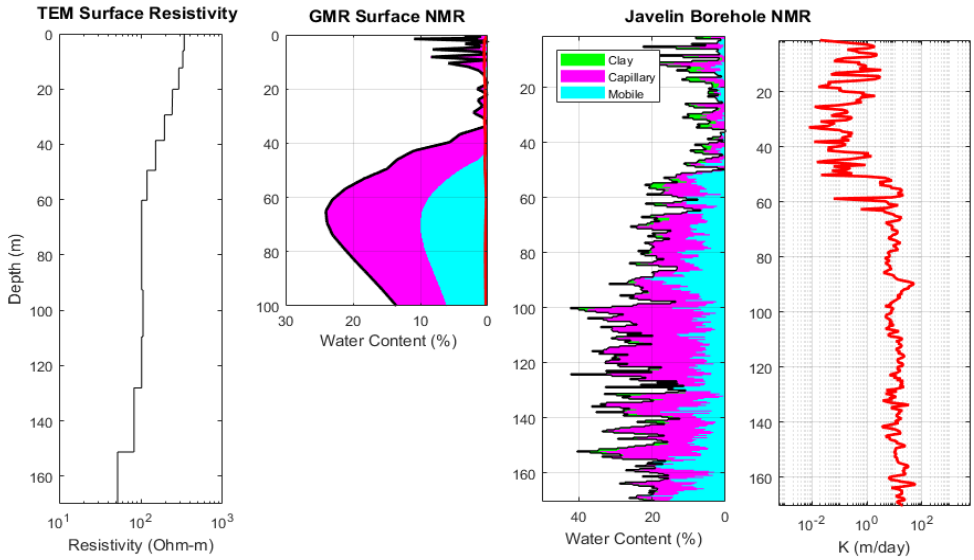
Javelin® NMR Logging Tool

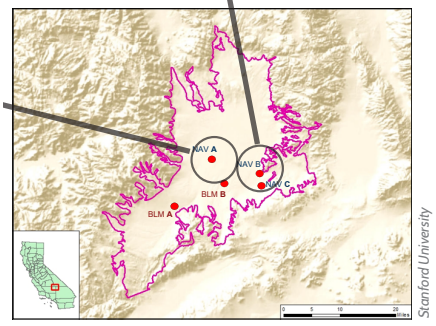
GMR Surface NMR Instrument

Results

Co-located downhole NMR, surface NMR, and TEM measurements were taken at 6 locations across the valley over 2 weeks. The results demonstrated the unique capability of NMR measurements to image and map hydrological properties directly, resolve ambiguities inherent in electrical measurements and lithological data, and reveal localized aquifer features and impermeable zones not previously known or fully appreciated.







"Takeaway"

This successful 2-week pilot study demonstrated the tremendous value and cost-effectiveness of utilizing NMR geophysical measurements to quantitatively and qualitatively measure aquifer properties for basin-scale groundwater modeling. On the basis of these results, Stanford University recommended an expanded mapping program of wide-area airborne TEM complimented by NMR logging in available existing wells and surface NMR in areas where wells are non-existent or where new drilling is not feasible.

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Acknowledgements: Indian Wells Valley Water Authority, Stanford University.

References: Behroozmand, A. A., Crews, J., Knight, R. Aquifer characterization in the Indian Wells Valley, California using the TEM and NMR geophysical techniques, presented at 30th Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP), 19-23 March 2017, Denver, United States.