Biography for Dr. Barry Freifeld

Dr. Barry Freifeld is a mechanical engineer at the United States Department of Energy, Lawrence Berkeley National Laboratory's Energy Geosciences Division, where he has worked since 1992. He currently serves as the Department Head for Hydrogeology. He received his Master's degree in Mechanical engineering from the University of California, Santa Barbara and a PhD in Civil and Environmental Engineering from the University of California at Berkeley. His current work is primarily in advancing monitoring technology, where he has pioneered methods of integrated monitoring incorporating fluid samplings, geophysical arrays, and fiber-optic systems for life-of-well applications. He has worked in diverse areas, including vadoze zone flow and transport, geothermal energy extraction, arctic systems, and carbon sequestration.

Fiber-optic Sensing Technology for CCS Monitoring

Monitoring the safe storage of CO_2 in the subsurface is challenging because it requires interrogation of the deep earth over large areas for multi-decadal time scales. Fiber-optic sensing technologies have proven robust and reliable and can collect data with high spatial and temporal resolution. Mature distributed fiber-optic technologies exist for monitoring temperature, strain and acoustic signals. Less mature are techniques for measuring distributed pressure and chemical sensing. Using examples from CO2SINK in Ketzin, Germany, the Aquistore Project in Saskatchwan, Canada, and the Otway Project in Victoria, Australia, we examine distributed fiber-optic monitoring of CO_2 sequestered in brine reservoirs.

At the CO2SINK site distributed temperature sensors utilized changes in thermal properties to spatially identify the location of CO_2 in the formation. Distributed acoustic sensing (DAS) has been used at both Otway and Aquistore for VSP acquisition. We compare DAS with geophones and show that the technology is sensitive enough to spatially resolve $_{CO2}$ in the reservoir. Finally the ADM Intelligent Monitoring System project is an example of permanent reservoir monitoring using fixed seismic sources and fiber-optic receivers. Fiber-optic cables have been installed in wells and along two surface transects for monitoring the ongoing CO_2 injection. Future developments in fiber-optic sensing technology aim to improve sensitivity and resolution through the use of novel engineered fibers with controlled scattering centers.