Bay Area Geophysical Society Seminar Series

Single and Crosswell Imaging of Shallow CO_2 Accumulations: Examples from a Shallow Injection Experiment at the Carbon Management Canada CaMI FRS in Southeast Alberta, Canada

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In-person in Building 45 at UC Berkeley's Richmond Field Station (RFS) and on Zoom

Abstract:

Electromagnetic (EM) and seismic geophysical techniques offer the possibility of monitoring subsurface gaseous and/or super critical fluid CO_2 accumulations in saline reservoirs. The increasing replacement of water / brine in the pore space by gaseous CO_2 will reduce both the bulk rock density and seismic acoustic velocity while at the same time increasing the seismic attenuation. At the same time gaseous CO_2 has essentially an infinite electrical resistivity compared to the pore water, and thus the accumulation of CO_2 will increase the bulk-rock resistivity. This presentation will discuss the results of Lawrence Berkeley Lab's involvement in an experiment where supercritical CO_2 was injected at approximately 300m depth and then naturally flashed to replacing the pore water with bubbles of CO_2. The purpose of this shallow injection was to simulate CO2 leaking upward from a deeper storage reservoir and accumulating in a shallower

aquifer. LBNL's contribution to the project involved acquiring baseline cross-well seismic and EM data between two monitoring wells spaced 50m apart and straddling the injection well in November of 2017, and returning in December of 2021 to collect post-injection cross-well data after 41 tonnes of CO2 had been injected. Over this same time period, single-well electrical resistivity tomography (ERT) data were being autonomously acquired two to three times per week using a 16 electrode array installed outside one of the monitoring wells which is cased with non-conductive fiberglass casing. In this paper we first discuss the underlying physics of the different borehole-based seismic and EM monitoring techniques and describe why they are sensitive to the presence of CO_2. This discussion is followed by the description of the experiment at the Carbon Management Canada Containment and Monitoring Institutions (CaMI) Field Research Station (FRS) test site. The remainder of the talk will describe the data as well as attempts to image it, and also describe why the various geophysical techniques ran into problems providing images of the resulting plume.

Presenter's Bio:

David L. Alumbaugh received a B.S. in Geological Sciences from San Diego State University in 1986, and a Ph. D. in Material Sciences and Mineral Engineering from the University of California Berkeley in 1993. From 1993 to 1999 he was a scientist at Sandia National Laboratories, and from 1999-2005 served as professor at the University of Wisconsin Madison. In 2004 He joined Schlumberger's EMI Technology Center in Richmond, CA where he helped to commercialize cross-well electromagnetic imaging as an oil-field offering. After a short stint at Chevron Energy Technology Company from 2011 to 2013, he joined NEOS GeoSolutions in Pleasanton, CA where he remained until 2018. Since 2019 he has been a Staff Scientist in the Energy Geosciences Division at Lawrence Berkeley National Laboratory. His research interests are focused on electromagnetic characterization and imaging of the Earth's subsurface as well as multiphysics data integration, and he serves in a leadership role of LBL's Geologic Carbon Storage and Hydrocarbon Science programs. He is the author/co-author of over 60 peer reviewed publications, 7 book chapters, 15 invited talks and presentations, and 14 US patents.

Zoom meeting information:

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