Bay Area Geophysical Society Seminar Series

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Surface and Downhole Seismic Monitoring Suggests that Multiphase CO2 Flow May Reactivate a Small Fault in a Clastic Reservoir

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Weds, March 1st, 2023 5 PM PST -- Hybrid Seminar

In-person in Room 104 at Building 74 LBNL campus

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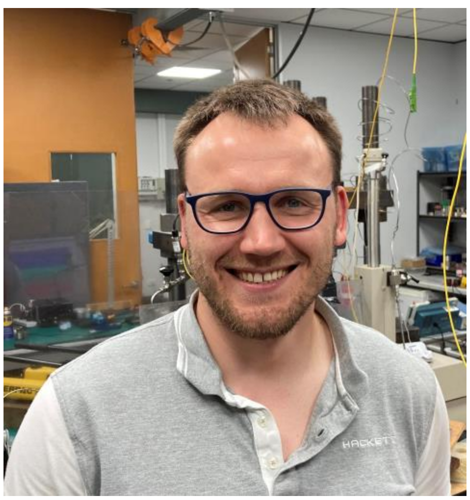
Abstract:

Induced seismicity is often perceived as one of the main risks for geological storage of carbon dioxide. Therefore, microseismic monitoring is a necessary component for the storage projects. However, only tfour dedicated CO_2 injections into saline aquifers have led to detectable microseismic events, with the largest documented event having a moment magnitude of 2.3. This study presents another field experiment, CO2CRC Otway Project, where two small injections of supercritical CO2 (15,000 tonnes and 0.2 MPa pressure) into a good sandstone aquifer induced detectable seismicity.

These two leakage-like twin injections were monitored by using both, buried geophone array and multi-well DAS array. In more than two years of monitoring for each injection we detected 17-

20 microseismic events that can be confidently attributed to the injections (maximum moment magnitude M_W0.1). The DAS array has sensitivity sufficient for detection and location of induced events with ~ M_W−2 in a monitoring borehole located up to 1,500 m away. Thanks to the dense spatial sampling by the DAS, we were able to estimate the focal mechanisms for events with $M_W > -1.5$, although the monitoring boreholes provided very limited angular coverage. The main cluster of the events has the same location and source mechanism as the one triggered by a previous CO2 injection at the Otway Project site, Stage 2C. Surprizingly, the Stage 2C and Stage 3 events closely followed the actual movement of the CO2 saturation plume front (not the pressure front), as observed using controlled-source reflection seismic images. The nature of the plume-fault interaction remains unclear, but some alteration of the fault gouge by CO2 might be responsible for the faults' reactivation by the pressure perturbation. Importantly, the seismogenic fault could not be identified in the seismic imagesand was only revealed by DAS observations, which also demonstrated the signature of fluid-rock interaction, which may control the CO2 flow. It is important to note that the seismogenic fault could not be identified in the seismic images prior to the injection. Only through the high-precision tracking of the two injections using the DAS array we could detect and characterize the reactivated fault.

Presenter's Bio:



Dr. Stanislav Glubokovskikh is a Research Earth Scientist at the Energy Geosciences Division (EGD) at the Lawrence Berkeley National Laboratory. Prior to the Berkeley Lab, he was working as a Senior Research Fellow at Curtin University (Perth, Australia) and a number of research institutions in Russia. Dr. Glubokovskikh's contribution to the field of seismic reservoir characterization and rock physics has been recognized by several awards from the geophysical professional societies. He also serves as an associate editor for rock physics section at GEOPHYSICS. Right now, Dr. Glubokovskikh focuses on the development of novel algorithms for streamline processing/interpretation of geophysical and engineering measurements to optimize the subsurface operations, such as: hydraulic fracturing, geothermal reservoir stimulation, injection of carbon dioxide, and well completion. A completely different research topic has to do with the digital rock physics workflows for rock physics diagnostic of the reservoir rocks.

Zoom meeting information:

Zoom link: https://us06web.zoom.us/j/86920796741?pwd=bDBxajYrdElXTFBEL2ZuSVVwSHRudz09
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