Livermore develops the world's deepest ERT imaging system for CO2 sequestration

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AN ERT electrode band, mounted on non-conductive casing, is prepared for installation. Electrodes are protected by non-conductive, epoxy-based centralizers.

(Phys.org) —Lawrence Livermore National Laboratory researchers have broken the record for tracking the movement and concentration of carbon dioxide in a geologic formation using the world's deepest Electrical Resistance Tomography (ERT) system.

The research provides insight into the effects of geological sequestration to address the impact of greenhouse gases.

The team led by LLNL's Charles Carrigan obtained time lapse electrical resistivity images during the injection of more than 1 million tons of carbon dioxide (CO_2) more than 10,000 feet deep in an oil and gas field in Cranfield, Miss., which represents the deepest application of the imaging technique to date. The previous depth record of about 2,100 feet was held by the CO2SINK Project Consortium in Ketzin, Germany.

"The images provide information about both the movement of the injected CO_2 within a complex geologic formation and the change with time of the distribution of CO_2 in the porous sandstone reservoir," Carrigan said.

Deep geologic sequestration of CO_2 is being evaluated internationally to mitigate the impact of greenhouse gases produced during oil- and coal-based energy generation and manufacturing. Natural gas producing fields are particularly appealing sites for sequestration activities because the same geologic barrier or cap rock permitting the subsurface regime to act as a long term natural gas reservoir also can serve to permanently contain the injected CO_2.

ERT allowed Xianjin Yang, another member of the LLNL team, to make a movie of the expanding CO_2 plume as it fills the sandstone region between the two electrode wells. To do this required analyzing months of data and using only the highest quality results to produce the images.

The team reports on the design, placement and imaging from the world's deepest ERT system in the June 1 online issue of the *International Journal of Greenhouse Gas Control*. The research also will appear in an upcoming print copy of the journal.

ERT can potentially track the movement and concentration of the injected CO_2 as well as the degree of geologic containment using time-lapse electrical resistivity changes resulting from injecting the fluid into the reservoir formation.

Installing each ERT array in the sequestration reservoir required designing all cabling and electrodes, which were externally mounted on the borehole casing, to survive the trip more than 10,000 feet down a crooked borehole with walls made jagged by broken rocks.

The team then used the ERT array in a challenging environment of high temperature (260 degrees Fahrenheit), high pressure (5,000 psi) and high corrosive fluids to effectively detect CO2 breakthroughs and CO2 saturation changes with time.

"This is a near-real time remote monitoring tool for tracking CO2 migration with time lapse tomographic images of CO2 concentration," Carrigan said.

When converted to CO2 concentration, the images provided information about the movement of the injected CO2 within a complex geologic formation as well as how the storage of the CO2 changed with time.

Carrigan said that given concerns about injection-induced fracturing of the cap rock seal causing leakage of CO2 from the reservoir, higher-resolution ERT also may have an application as an "early-warning" system for the formation of fracture pathways in cap rock that could result in environmental damage to overlying or nearby water resources. Another potential application involves monitoring the boundary of a sequestration lease to ensure that CO2 does not migrate across the boundary to an adjacent parcel.

Provided by Lawrence Livermore National Laboratory