Project Summary/Abstract

Proposer: GroundMetrics, Inc.
Project Title: Borehole-deployed electric field sources and sensors for permanent monitoring of CO_2 sequestration in deep reservoirs, Phase II
Principal Investigator: Dr. Andrew Hibbs
Topic number/subtopic letter: Topic 13: Advanced Fossil Energy Separations and Analysis Research
Subtopic 13.b: Subsurface CO_2 Sequestration Monitoring

Statement of the Problem
Assuring the long-term, safe storage of CO_2 requires the development of effective monitoring strategies that have minimal environmental impact. Models show measuring the resistivity contrast between injected CO_2 and the host reservoir offers a means to image directly CO_2 volume and saturation in situ, with the highest accuracy, while producing no noise or other emissions that impact humans. However, there is presently no cost effective method to acquire such subsurface resistivity data over a large area.

Current Solutions
The new borehole to-surface electromagnetic (BSEM) survey configuration has been shown to image oil-to-water contact in a 2000 m deep oil reservoir over an area of 25 km^2, thereby extending resistivity methods to deep reservoirs. The resistivity contrast between brine and oil and brine and CO_2 is almost the same, and models show that the configuration should work at the Phase II test site to image CO_2 over an area of approximately 50 km^2. However, the source used in BSEM must be located at the bottom of a borehole, which greatly increases cost and reduces system life and reliability.

Phase I Project
A new type of EM source that does not require any downhole components was compared to three other potential downhole designs (including BSEM) and found to be comparable or better in all categories. The source is easy to deploy and was tested at a functioning oil field close to, and in the same geology, as the proposed Phase II test site. The measured data agreed very closely with model predictions.

Phase II Project
A controller will be developed to scale up the prototype source to do a complete survey. Two surveys will be conducted at the Kevin Dome CO_2 sequestration site. The first will occur before CO_2 injection and the second after 150,000 tons of CO_2 has been injected. The resistivity images will be compared to a full suite of seismic, well logs and geochemical data acquired in parallel. These will be the first such deep surveys in the US and a critical first step for CO_2 applications and for commercial introduction of this method into the US for mapping the distribution of CO_2, oil, water and steam in reservoir formations.

Commercial Applications and Other Benefits
Commercial applications exist in the CO_2 sequestration industry and the oil extraction industry, where injected fluids (water, CO_2, steam) are used for secondary and tertiary oil recovery.

Key Words
Electromagnetic imaging, resistivity imaging, permanent monitoring, CO_2 mapping, CO_2 saturation, reservoir imaging, fluid boundary imaging, waterfood imaging, borehole to surface electromagnetic survey

Summary for Members of Congress
A new method for imaging fluids underground that has the potential to revolutionize many reservoir applications, including CO_2 sequestration, will be tested. Phase II will demonstrate the method for the first time, using new equipment that greatly reduces the cost and increases the capabilities.