PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Sequestration

02/2004

IN FIELD, CONTINUOUS, NON-INVASIVE SOIL CARBON SCANNING SYSTEM

Background

Global warming is promoted by anthropogenic CO_2 emissions into the atmosphere, while at the same time it is partially mitigated by carbon sequestration in the terrestrial ecosystem. However, a better understanding and monitoring of the underground carbon processes is cardinal for evaluating various strategies for carbon sequestration and quantification of the carbon stores for credits.

Brookhaven National Laboratory developed an instrument for carbon analysis in soil based on inelastic neutron scattering (INS). INS offers a non-invasive means for continuously monitoring the soil carbon inventory over both specific plots and large areas. This technique can significantly improve quantification of the efficacy of carbon sequestration methodologies. The proposed instrument enables a continuous scan and evaluates the mean soil carbon content in the field to a depth of about 20cm. This project offers to fill a void that exist in instrumentation in the area of monitoring belowground carbon processes in a fashion that is repetitive and provides a representative value for the soil carbon content over large areas. At present, carbon concentrations in soil are assessed indirectly using analytical models, and directly by taking core samples and subsequently subjecting the samples to physical and chemical analysis in the laboratory. However, the extensive variability of soil carbon both laterally and with depth in nearly every type of terrain requires large number of samples for statistically meaningful determination of mean carbon concentration with an acceptable level of error. This analysis process is labor intensive, expensive, slow and not amenable to up scaling for analysis of soil carbon at continent to global scales. Two new approaches utilizing laser induced breakdown and near-infra-red spectroscopy, are being developed. These two new techniques although less labor intensive are invasive and represent a micro-point and surface measurements. Thus they are irreproducible for the specific site sampled, since the point of measurement, in each of the cases, is essentially destroyed. The new instrument being developed at BNL overcomes the shortcomings of the current technologies.

Components of a future system to be assembled for field measurements.

Primary Project Goal

The purpose of this project is the development of an instrument with the capability for safe, rapid, non-destructive, multielemental, in situ soil carbon quantification and profiling over large areas and volumes.

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PARTNERS

Brookhaven National Laboratory

COST

Total Project Value:
$459,202

DOE/Non-DOE Share:
$459,202 / $0

Objectives

- The short-term objectives of present work are to construct a deployable prototype INS scanner for non-destructive soil carbon measurements in the field and to perform calibration and field verification of the system.
- The long-term objective is to perform measurements in various soil types in which the soil carbon content is well characterized. The system also will be used for comparison and possible development of conversion factors to scale specific point measurements obtained by other means to large field values.

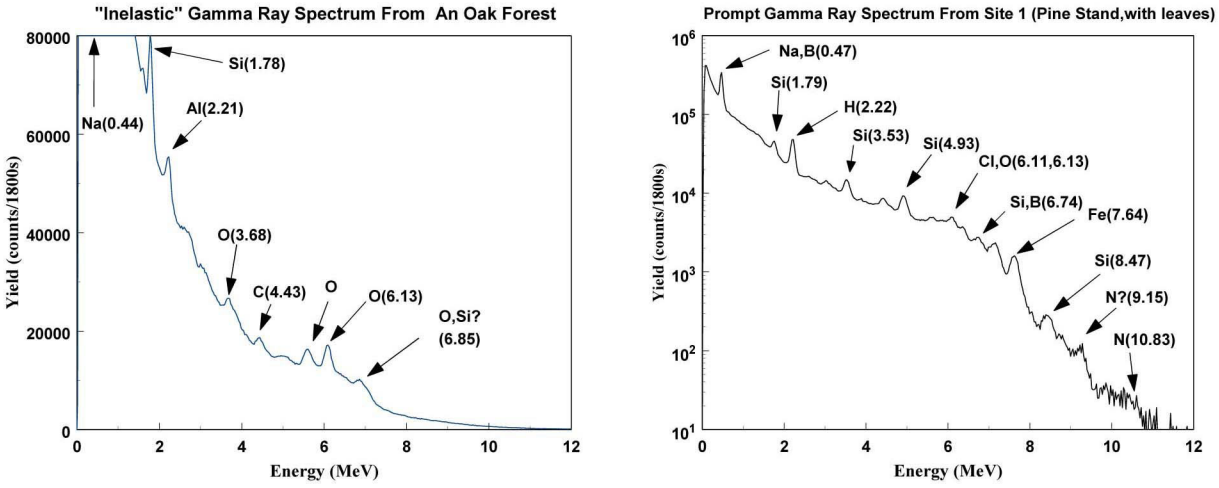
Accomplishments

- A patent application for an INS system to measure carbon in soils is pending.
- During FY 2003 the first set of outdoor calibration measurements in a 4'x 5'x1.5' sand pit was obtained using sand mixed with known amounts of carbon.

Field measurement in an oak forest using an INS prototype instrument.

Benefits

This project is developing a robust, flexible, non-invasive, scanning system for in situ monitoring and verifying temporal changes in soil carbon over large areas. The anticipated benefit from such a system is the ability to monitor below ground carbon balances without disturbing the soil. Furthermore, the system enables continuous scanning of large areas thus providing a true mean carbon concentration in the soil. The proposed system enables, for the first time, repetitive measurement of the same site, thus allowing sequential monitoring of large areas. Collaboration with soil scientists from USDA ARC, as recommended by the NETL staff, will be established for final system testing using their well characterized fields.



Inelastic and prompt gamma spectra showing the results of the INS system.