Detection of Low-level Carbon Dioxide Leakage from Carbon Sequestration Sites using Real-time ^{13}C Analysis

Chris W. Rella[1], Iain Green[1], Samuel Krevor[2], and Sally Benson[2]

[1] Picarro, Inc., 480 Oakmead Parkway, Sunnyvale, California 94085.
[2] School of Earth Sciences, Stanford University, Stanford, CA 94305

Principal Contact: Chris W. Rella, Director of Research and Development, Picarro, Inc, 480 Oakmead Parkway, Sunnyvale, California 94085, Phone-(408) 962-3941, Fax-(408) 962-3200, rella@picarro.com.

Abstract

A crucial aspect of all carbon sequestration projects is the ability to verify that the sequestered carbon is not re-released into the atmosphere. It is therefore important to develop techniques to detect even low level carbon dioxide emissions over the extended area of a sequestration field, and to distinguish these emissions from other natural sources of carbon dioxide. Stable isotope analysis has been proposed as a signature to distinguish between petrogenic carbon dioxide and biogenic carbon dioxide; petrogenic carbon dioxide tends to be more depleted in ^{13}C than biogenic sources. We present results of a portable stable carbon isotope ratio analyzer for carbon dioxide, based on wavelength scanned cavity ringdown spectroscopy that has been used to detect, locate, and characterize an intentional leakage of CO_2 from an underground pipeline at the ZERT experimental facility in Bozeman, Montana. Rapid (1 hour) walking surveys of the 100 meter by 100 meter site surrounding the pipeline were collected using this mobile, real-time instrument. The resulting concentration and ^{13}C isotopic abundance maps were analyzed using Keeling plots, permitting not only the identification of specific leakage locations, but providing the ability to distinguish petrogenic sources of CO_2 from biogenic sources. The ability to rapidly and reliably detect $^{12}CO_2$ and $^{13}CO_2$ concentration anomalies and identify the isotopic composition of the source flux provides a powerful and practical tool for detecting leakage from CO_2 sequestration sites.