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In situ Carbon Isotopic Exploration of an Active Submarine Volcano

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Abstract

The geologic and biogeochemical cycling of carbon in deep ocean environments has important implications for our understanding of the functioning of Earth systems across a wide range of spatial and temporal scales. To improve our ability to study the cycling and fluxes of carbon in the deep ocean, new technologies are emerging for making *in situ* measurements of carbon compounds over a range of environmental contexts. Within many of these deep-sea environments, fluxes of carbon compounds often occur as either venting fluids or rising gas bubbles. Key compounds of interest include methane (CH_4), dissolved inorganic carbon (DIC), and carbon dioxide (CO_2) – a component of DIC. In particular, measurement of the carbon isotopic composition ($\delta^{13}C$) of these pools can offer a better understanding of the nature of sources, fluxes, and cycling processes involving these compounds. Here we present the advancement of an *in situ* laser spectrometer (initially developed for measurement of $\delta^{13}C_{CH4}$ only) into a sensor that can measure $\delta^{13}C$ of both CH_4 and CO_2 in both deep-sea bubble plumes as well as geologic fluids. We present results of a 2014 investigation of a back arc submarine volcano (Kick'em Jenny) in the Caribbean Sea. *In situ* isotopic analysis of both bubbles and fluids suggest a primarily thermogenic origin for CH_4 and a magmatic origin for CO_2, yet highlight the occurrence of some heterogeneities indicating locally elevated contribution of organic matter to DIC fluxes.

Keywords: laser spectroscopy; deep-sea instrumentation; carbon isotopes; methane; carbon dioxide; back arc volcano; Kick'em Jenny; E/V Nautilus; Cruise ID NA054

1. Introduction

The cycling of carbon in deep marine environments reflects the combined influences of a broad range of physical, geological and biological processes

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