Geophysical Research Abstracts
Vol. 15, EGU2013-12133, 2013
EGU General Assembly 2013

Using isotopes to understand methane formation, removal and transport in the East Siberian Arctic Shelf

Célia Julia Sapart (1), Natalia Shakhova (2), Igor Semiletov (2), Joachim Jansen (1), Carina van der Veen (1), and Thomas Röckmann (1)

(1) Institute of Marine and Atmospheric Research, Utrecht University, Atmospheric physic and chemistry, UTRECHT, Netherlands (c.j.sapart@uu.nl), (2) International Arctic Research Center, University of Alaska Fairbanks, Alaska, USA

Methane is a strong greenhouse gas emitted by human activity, but also by natural processes. Large uncertainties exist on the future contribution of natural methane sources (e.g. wetlands and geological sources) to the radiative forcing of the Earth. The Arctic regions are of special concern, because they undergo above average warming causing the thawing of permafrost thus the remobilization of large amount of organic carbon as potential methane precursor.

The East Siberian Arctic Shelf (ESAS) is the shallowest and broadest continental shelf on Earth and is overlaid by thawing sub-sea permafrost. In this carbon-enriched environment, in presence of microbes and under anoxic conditions, microbial methane production is enhanced in the seafloor sediment. The methane produced can be stored in the sediment as gas hydrate, oxidized by methanotrophs or diffuse through the water column to the atmosphere. Moreover, old methane (microbial or thermogenic) from the deep ocean crust can be transported to the surface and undergo similar processes. Since a few years, large methane fluxes have been identified to the atmosphere of the ESAS, but the quantitative and qualitative understanding of the methane formation/removal/transport mechanisms remains poor.

Between 2008 and 2012, several winter (ice drilling) and summer (cruise) campaigns have been performed to retrieve methane samples from different depths in the sediment and in the water column of the ESAS. We performed chemical analyses as well as measurements of methane mixing ratio and isotopic composition (stable and radioactive) on those samples. Our results allow identifying and potentially quantifying different types of methane formation/removal pathways. Moreover, they show that transport throughout the sediment and the water column can significantly alter the stable isotopic signature of the methane produced in the sediment. Hence analyzing methane stable isotopes on atmospheric samples only cannot allow discriminating between the different types of methane sources (thermogenic or microbial). Our findings also demonstrate that depending on the timescale large gas hydrate degassing events in the Arctic Ocean may not be detectable in measuring the methane stable isotopic composition in the atmosphere.