Tracing Methane production by plants using compound-specific stable isotope ratios

F. Keppler[1], J.T.G. Hamilton[2], T. Röckmann[3], I. Vigano[3]

[1]Max Planck Institute for Chemistry, Mainz, Germany
[2]Agri-Food Biosciences Institute, Newforge Lane, Belfast BT9 5PX, UK
[3]Institute for Marine and Atmospheric Research, Utrecht University, The Netherlands

Methane is the second most important anthropogenic greenhouse gas after carbon dioxide and the most abundant reduced organic compound in the atmosphere, which makes it an important player in atmospheric chemistry. Approximately 600 million tons of it - both anthropogenic and natural – escape into the atmosphere every year. According to established knowledge, it is produced primarily by methanogens under anaerobic conditions in wetlands, rice fields, landfills and the gastrointestinal tracts of ruminants and termites, with non-microbial emissions from fossil fuel usage and biomass burning. Three years ago it was shown for the first time that plants are able to produce methane under aerobic conditions. This discovery caused considerable controversy and debate amongst the scientific community and the general public because of their potentially far reaching implications. The principle scientific questions that have emerged are: if, by how much, and by what mechanisms can methane be emitted from plant matter under normal atmospheric conditions without microbial activity. Some subsequent studies could not confirm the original findings of Keppler et al. (2006). However, several more recent studies – some of them using stable isotope techniques - have now reported an aerobic methane emission from plants. In this presentation the recent developments in the research field of aerobic methane formation from vegetation will be summarized. The main focus of the talk will be on the employment of compound-specific stables isotope ratios, both carbon and hydrogen, to trace and distinguish the formation of methane from plants by different processes. Furthermore, the isotope signatures of methane emitted from living and dead plants will be compared with those measured for microbial processes.