



Contribution ID: 189 Contribution code: PSA-51

Type: Poster

Rapid UV-Oxidation setup at ETH for AMS radiocarbon analysis of dissolved organic carbon in marine and freshwater samples

Monday, 21 October 2024 17:15 (20 minutes)

Dissolved organic carbon (DOC) is a major, yet little understood component of the global carbon cycle. Although radiocarbon analysis of DOC provides valuable information on the origin and age of this pool, the number of measurements, particularly in marine systems, is limited by the complexity and low efficiency of existing methods. These methods generally use UV irradiation to oxidize the organic carbon, and then perform ^{14}C analyses on the resulting CO_2 . Disadvantages of most currently applied UVox methods include being limited to the processing of only one sample at a time, the large sample volumes required, and relatively high processing blanks. Here, we present a compact UV-Oxidation system, where up to 12 water samples can be oxidized simultaneously in separate quartz reactors arranged around a single UV lamp. This simple setup uses helium instead of vacuum to speed up the extraction of the CO_2 formed after oxidation. Key improvements of the new UVox setup include: 1) Reduced required sample volumes (30- 60 ml instead of 1L), as samples are measured for ^{14}C with the Micadas gas ion source, 2) High UV oxidation efficiency for standards (96%), 3) No KI trap needed, 4) Decreased processing time with the possibility of oxidizing up to 12 samples in 4-6 h, 5) And the possibility of combining CO_2 from different reactors to one trap, enabling the measurement of samples with very low DOC concentrations. We determined a low background of $2.3 \pm 0.6 \mu\text{gC}$ with $\text{F}^{14}\text{C} = 0.27 \pm 0.05$ on fossil and modern standards dissolved in pre-irradiated Milli-Q water. We will present the reproducibility of the line and first measurements on DOC samples from Swiss lakes and the Sargasso Sea.

Student Submission

No

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Session Classification: Poster Session A

Track Classification: Small C-14 Sample Techniques and Applications