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Measurement of ultra-small CO2 samples with an EA-IRMS-AMS system at CologneAMS

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In the CRC1211 project "Evolution at the Dry Limit", precise dating analysis of soil samples from the Atacama Desert is essential. These soil samples result in ultra small CO_2 samples and have a carbon content of 2-20µg. At CologneAMS ultra-small samples are measured as CO_2 with, an elemental analyzer (EA), an isotope ratio mass spectrometer (IRMS) and the 6MV AMS system, by the use of a gas injection system (GIS). This EA-IRMS-AMS setup enables fully automated, online analysis of $^{14}C/^{12}C$ ratios and provides accurate and precise $\delta^{13}C$ values.
The measurement process begins with oxidization of the samples to CO_2 gas in the EA. After this, the $\delta^{13}C$ values are measured with the IRMS with only 10 percent of the gas while the remainder is transferred to the GIS, from which it is transferred to the AMS. For standard AMS measurements the initial two minutes of data are typically disregarded, due to the instability of the ion source output. Such a practice would significantly reduce data availability for ultra-small samples with carbon content below 10 µg. Typical measurement times range from 1-10 minutes. To still enable longer measurement times and reduce the loss of sample material during the ion source output stabilization, the sample is diluted by the addition of blank gas. Dilution takes place within the GIS syringe, where a precise amount of blank gas is introduced to the sample, thereby giving time for the ion source output to stabilize and to extend the measuring time.
Additonally our investigation also focused on enhancing fractionation correction in 14C data evaluation. By simultaneously measuring $\delta^{13}C$ values with AMS and IRMS, we found that they agree with each other within their respective errors. While the $\delta^{13}C$ AMS values scatter multiple orders higher than the $\delta^{13}C$ IRMS values we concluded that the $\delta^{13}C$ IRMS values could be used for a better fractionation correction of AMS measurements.
This contribution will give an overview of the first ultra-small samples measured with the EA-IRMS-AMS system.

Student Submission

Yes

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