Geophysical Research Abstracts
Vol. 19, EGU2017-15002, 2017
EGU General Assembly 2017

Gas adsorption and desorption effects on high pressure small volume cylinders and their relevance to atmospheric trace gas analysis

Ece Satar (1,2), Peter Nyfeler (1,2), Céline Pascale (3), Bernhard Niederhauser (3), Markus Leuenberger (1,2)

(1) Climate and Environmental Phyiscs, Phyiscs Institute, University of Bern, Switzerland (satar@climate.unibe.ch), (2) Oeschger Centre for Climate Change Research, University of Bern, Switzerland, (3) Swiss Federal Institute of Metrology (METAS), Bern-Wabern, Switzerland

Long term atmospheric monitoring of trace gases requires great attention to precision and accuracy of the measurement setups. For globally integrated and well established greenhouse gas observation networks, the World Meteorological Organization (WMO) has set recommended compatibility goals within the framework of its Global Atmosphere Watch (GAW) Programme [1]. To achieve these challenging limits, the measurement systems are regularly calibrated with standard gases of known composition. Therefore, the stability of the primary and secondary gas standards over time is an essential issue. Past studies have explained the small instabilities in high pressure standard gas cylinders through leakage, diffusion, regulator effects, gravimetric fractionation and surface processes [2, 3]. The latter include adsorption/desorption, which are functions of temperature, pressure and surface properties. For high pressure standard gas mixtures used in atmospheric trace gas analysis, there exists only a limited amount of data and few attempts to quantify the surface processes [4, 5]. Specifically, we have designed a high pressure measurement chamber to investigate trace gases and their affinity for adsorption on different surfaces over various temperature and pressure ranges. Here, we focus on measurements of CO_2, CH_4 and CO using a cavity ring down spectroscopy analyzer and quantify the concentration changes due to adsorption/desorption. In this study, the first results from these prototype cylinders of steel and aluminum will be presented.

References

[1] World Meteorological Organization (WMO), Global Atmosphere Watch.(GAW): Report No. 229, 18^{th} WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases and Related Tracers Measurement Techniques (GGMT-2015), 2016.

[2] Keeling, R. F., Manning, A. C., Paplawsky, W. J., and Cox, A. C.: On the long-term stability of reference gases for atmospheric O_2 /N_2 and CO_2 measurements, Tellus B, 59, 10.3402/tellusb.v59i1.16964, 2007.

[3] Langenfelds, R. L., van der Schoot, M. V., Francey, R. J., Steele, L. P., Schmidt, M., and Mukai, H.: Modification of air standard composition by diffusive and surface processes, Journal of Geophysical Research: Atmospheres, 110, n/a-n/a, 10.1029/2004JD005482, 2005.

[4] Leuenberger, M. C., Schibig, M. F., and Nyfeler, P.: Gas adsorption and desorption effects on cylinders and their importance for long-term gas records, Atmos. Meas. Tech., 8, 5289-5299, 10.5194/amt-8-5289-2015, 2015

[5] Miller, W. R., Rhoderick, G. C., and Guenther, F. R.: Investigating Adsorption/Desorption of Carbon Dioxide in Aluminum Compressed Gas Cylinders, Analytical Chemistry, 87, 1957-1962, 10.1021/ac504351b, 2015.