Helpling to Improve the Accuracy in Environmental Measurements

[1]Tracey Jacksier, [2]Arancha Oca, [3]David Vera and [3]Jaime Hernandez

[1]Air Liquide, Delaware Research and Technology Center, 200 GBC Dr., Newark DE 19702 USA; Calle San Norberto, 23 ES-28021 Villaverde, Madrid, Spain; [3]Air Liquide, Poligono Industrial de Guimar, Manzana III, Parcela 16-17, ES-38509 Candeleria Tenerife, Spain

Understanding Changes in the Earth's Climate

- **Long term and high precision measurements of GHG are necessary to understand changes in the Earth's climate**
  - Stable reference gas standards with low uncertainties and metrological traceability provide coherence and confidence to meet Metrology Organization and regulatory requirements

- **If the CO_2 and matrix have different isotopic signatures than the sample, erroneous results may be obtained**
  - For example, different isotopologues of CO_2 have different absorption bands
  - CO_2 in the environment has many isotopologues

Y. Tohjima et al., Journal of Geophysical Research: Atmospheres, 2009

Tropospheric Natural Air

- **Synthetic Air vs. Natural Air Standards**
  - It is quite possible that synthetic air will have isotopic ratios different from atmospheric natural air
  - Natural Air collected at an altitude of >2300 meters
- **Target Uncertainties**
  - The WMO Data Quality Objective is between 0.1% to 0.05% rel
- **ALPHAGAZ[TM] Natural Air**
  - Appropriate isotope ratio for $^{13}C/^{12}C$ for CO, CO_2, CH_4 as well as N_2O and SF_6 to enable the most accurate measurements (avoiding erroneous results owing to different isotopic signatures
  - Purification to eliminate traces of CO_2

Scientific Questions

- **Concentration Uniformity**
  - Do cylinders from the same batch have the same δ values?

$^{15}N_2O/N_2{}^{18}O$		
	$\delta^{18}O$ avg	$\delta^{18}O$ stdev
A1	-3.143	0.067
A2	-3.152	0.045
A3	-3.140	0.064
Total	-3.145	0.059

- **Transfilling**
  - Mother to Daughter Cylinder

Mother (‰, VPDP)
$\delta^{13}C$ in CO_2
-24.96

Transfill →

Daughter (‰, VPDP)			
$\delta^{13}C$ in CO_2			
1	-24.96	6	-24.98
2	-24.97	7	-24.98
3	-24.98	8	-24.98
4	-24.97	9	-24.96
5	-24.97	10	-24.97
Avg	-24.97		

- **Stability of $\delta^{13}C^{18}O_2$**
  - One year stability study

→ **Fractionation is not an issue during either cylinder filling or transfilling**

Summary

- The use of Natural Air and standards made with Natural Air as the matrix decreases errors in environmental measurements
- Stable Isotopic mixtures can be made without fractionation if the correct methodologies and equipment are used

Air Liquide