^{13}C and ^{18}O Isotope Effects Resulting from High Pressure Regulation and CO_2 Cylinder Depletion

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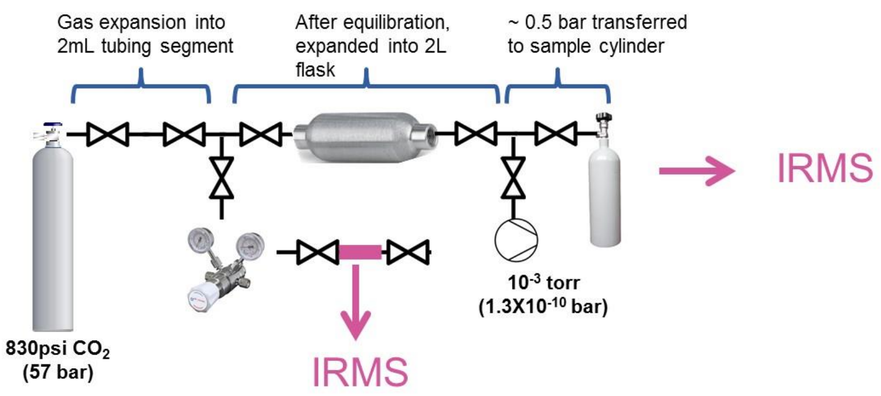
Stable Isotopes for Environmental Monitoring

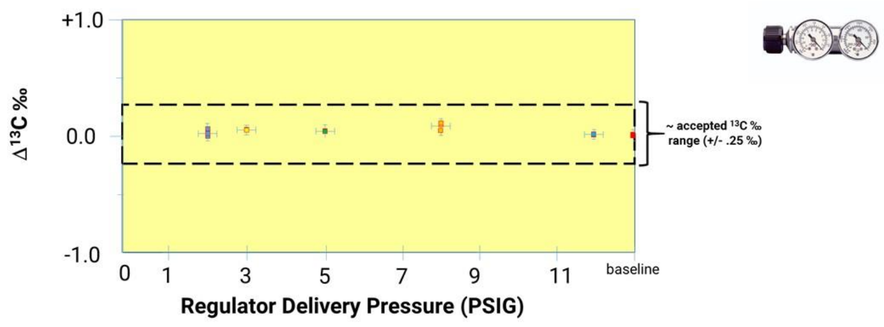
- Significant component of environmental research
  - Used for monitoring of landfill contamination, determining source stray gas in soils, and deciphering the origin and fate of nitrate in surface ground water
  - Isotopes in precipitation, combustion, volcanic activity, etc…
  - Concentrations for greenhouse gas determination, natural air monitoring
- FOCUS: Development of new ambient concentration isotopically characterized CO_2 standards that meet WMO DQO objectives

1 Validate Pressure Reduction from the Cylinder to IRMS Doesn't Cause Fractionation

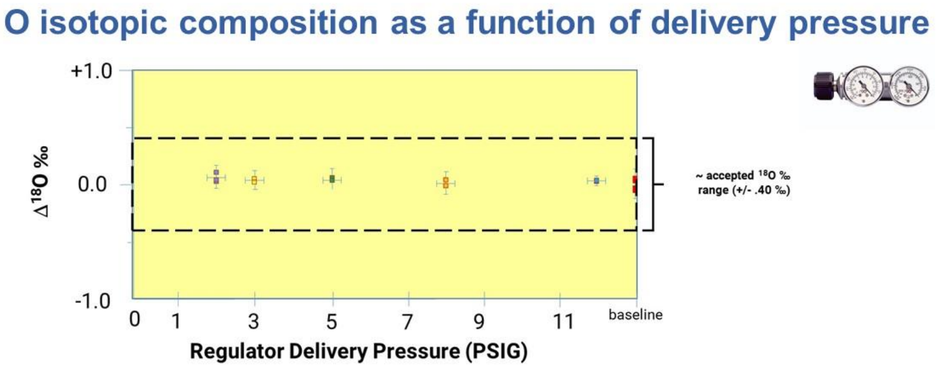
•Experimental configuration



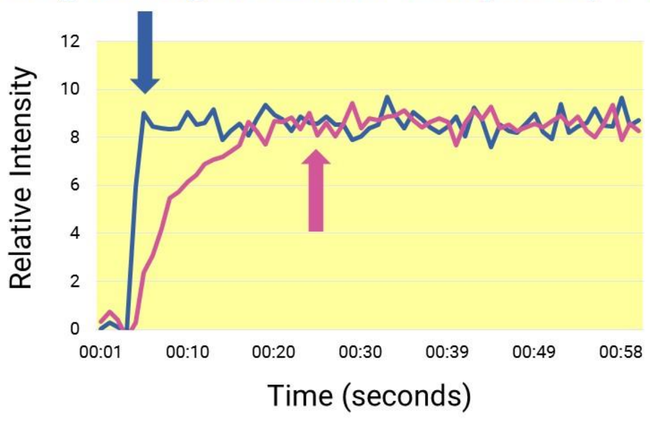
C isotopic composition as a function of delivery pressure

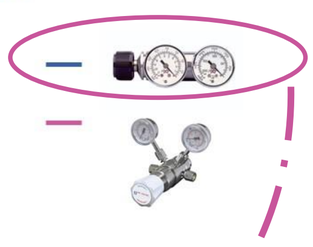


O isotopic composition as a function of delivery pressure



CO_2 flowing at 2L/min: Analysis by FTIR





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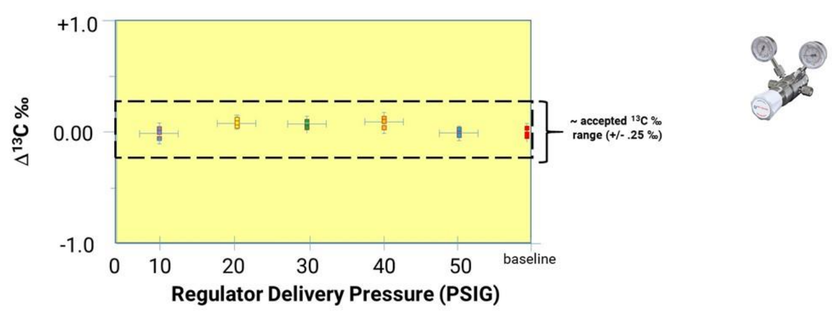
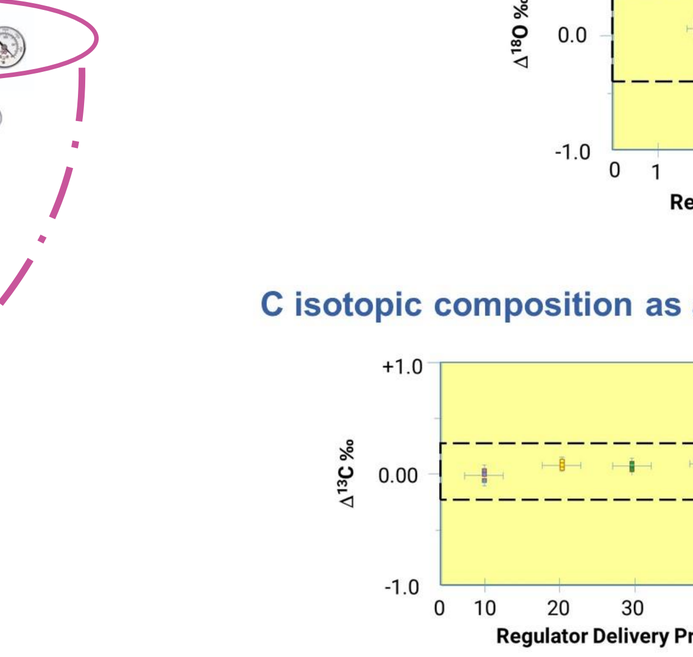
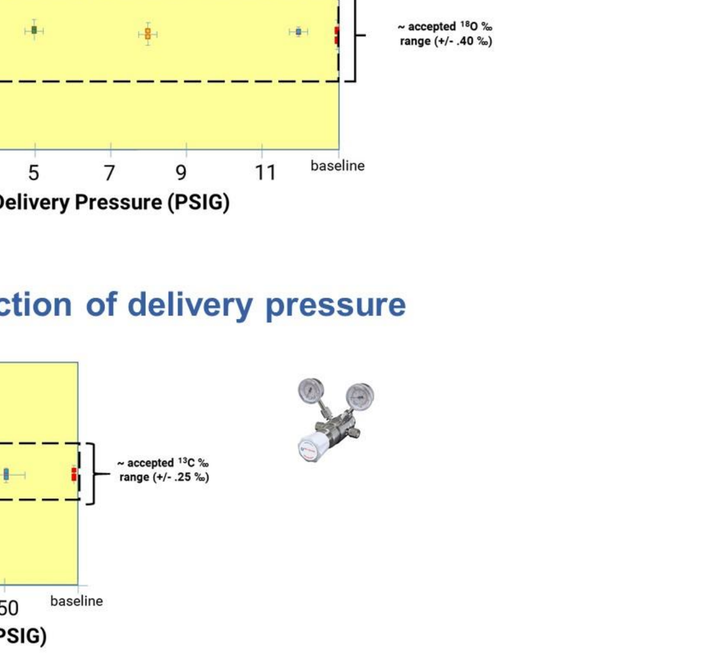


Low dead volume, 2 stage / piston regulator reaches steady state faster

Δ ‰ is the difference between regulated & unregulated flow

2 Depletion of LCO_2 Cylinder





- 21 Kg LCO_2 cylinder
- Withdrawal at ~500 mL/min to eliminate possibility of droplet formation in the gas stream
- If the withdrawal rate is too high to prevent equilibration, droplets of LCO_2 will alter the data

Summary

- Careful regulator selection eliminates possibility of fractionation
- Enriched C comes off first leaving the reservoir depleted in ^{13}C as the product bleeds off
- Depleted O comes off first leaving the reservoir enriched in ^{18}O as the product bleeds off
- For precise measurements meeting the WMO DQO, gaseous sources must be used and verified for each use

Air Liquide creative oxygen

Airgas an Air Liquide company