The Sercon CryoGas: for automated, high precision δ^2H and $\delta^{13}C$ analysis of gaseous and dissolved methane

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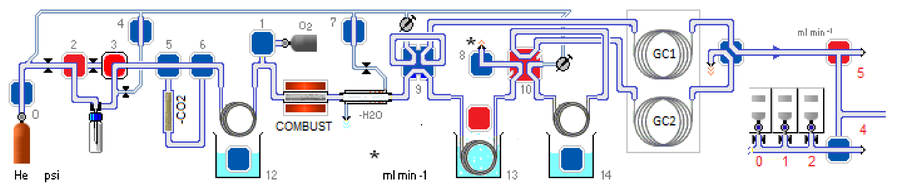
1. Introduction:

- Methane is the **third most important greenhouse gas** after water vapour and CO_2, contributing 20% of all radiative forcing from the long lived green house gases.
- **Isotopic analysis** of carbon ($^{13}C/^{12}C$) and hydrogen ($^{2}H/^{1}H$) in methane, can tell us by which process the methane has been formed. Enabling us to understand where methane pollution is originating from and mitigate against it.
- The new **Sercon CryoGas** (Figure 1) is an automated system for the high precision, rapid throughput analysis of both carbon and hydrogen isotopes in methane.

Figure 1: The Sercon CryoGas and HS2022 mass spectrometer, this is the first Sercon instrument built specifically for the analysis of C and H in methane.



2. Operation:

- Samples are introduced as a mixed gas, either atmosphere or an equilibrated headspace from water samples.
- In both hydrogen and carbon modes the CryoGas utilises **cryogenic trapping, chemical gas clean up and gas chromatography** to separate out air components (CO_2, N, O_2) from methane (Figures 2 and 3).
- Pyrolysis is used for δ^2H –CH_4 and combustion for $\delta^{13}C$-CH_4 analysis.

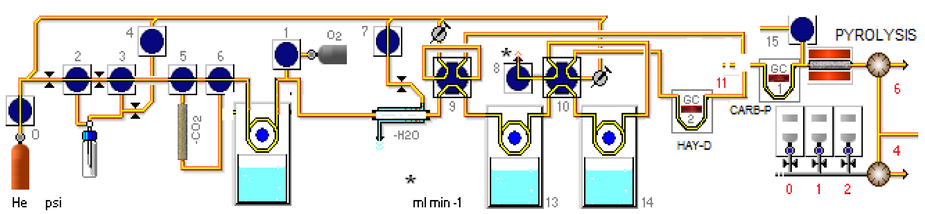


Figure 2: Schematics of the CryoGas system in both carbon (top) and hydrogen (bottom) modes. Showing a series of chemical and cryo traps as well as the configuration of GC columns/ vents for the separation of CH_4 from air components.

3 Results:

- **Instrument precision** on 150ml of air is <3‰ for δ^2H –CH_4 (Figure 4b) and <0.2‰ for $\delta^{13}C$-CH_4.
- The CryoGas can do **unattended runs** of either 21 samples of 150ml or >200 12ml samples at higher concentrations.

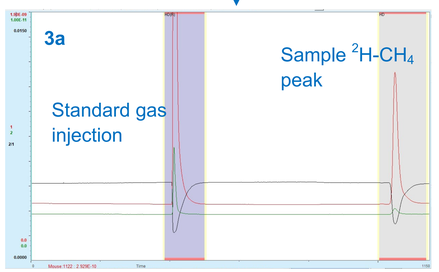
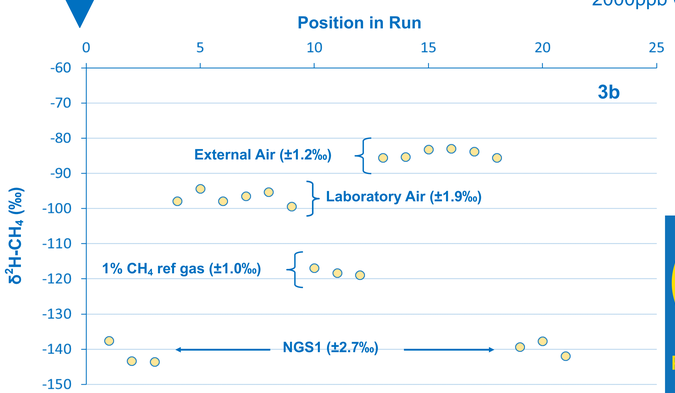


Figure 3a) A typical δ^2H –CH_4 in air output, with initial ref gas pulse followed by a >1 nano amp sample peak height.

3b) example data showing the CryoGas precision for 150ml of air and standards at 2000ppb CH_4.



Photography encouraged