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innovators in isotopes

Application note 024

A new technique for acid delivery for carbonate and DIC samples on the Sercon XYZ Autosampler

Organic molecules are primary composed of carbon, hydrogen, oxygen, nitrogen and sulphur. The stable isotope ratio of these light elements varies in components of the Earth, and is dependent upon processes which have caused fractionation to give values different from natural abundance. The $\delta^{18}O$ signature of water in the oceans is largely dependent upon the temperature of the Earth. The $\delta^{13}C$ of dissolved inorganic carbon (DIC) in the oceans has been hugely affected by anthropogenic activities since the industrial revolution. The changes that reflect fractionation processes leave their signature in natural archives, and these values, detectable via IRMS, enable us to investigate the climate of past and present times in order to understand how the climatic system of the Earth works, and how it responds to external forcing.

The measurement of stable isotopes in the carbonate shells of organisms which lived and died in our oceans and fell to ocean floor is possible through the analysis of sediment cores and sedimentary rocks, and gives us a thermometer of past ocean temperature.

The measurement of DIC in modern samples allows for an analysis of the sources and sinks of atmospheric trace gases, vital information in the drafting of international protocols within which countries around the world seek to work in an at-

The necessity for accurate and precise measurements of these isotopic signatures is paramount. Both carbonate and DIC analysis require the delivery of phosphoric acid to samples, in order that CO_2 be released into the headspace of the sample vial (after it is flushed with helium) and then transferred to the IRMS for isotopic analysis. The phosphoric acid used is viscous and corrosive, needles are prone to blocking, and many an isotope scientist has become frustrated that the automated systems used for acid delivery are prone to failure.

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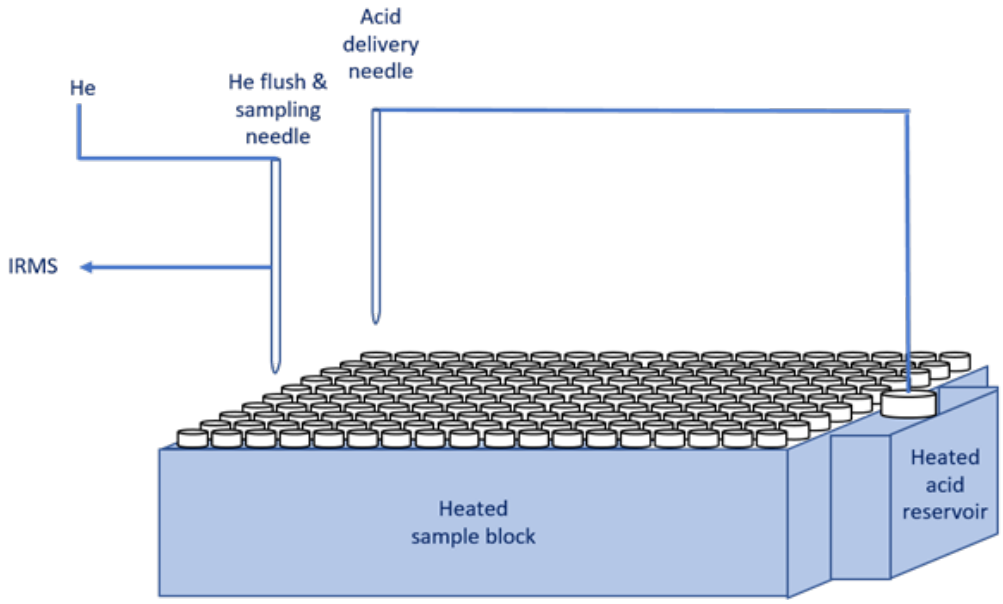
After extensive research at Sercon to find the best way of delivering acid into vials containing DIC and carbonate samples, we present the **smooth and simple** acid delivery system. The acid reservoir is kept at an elevated temperature inside the heated sample tray, in order that the acid viscocity is kept low. The acid delivery line is kept as short as possible, in order that the acid does not have time to cool between the reservoir and the sample vial. Two needles are used, one for acid delivery, the other for sampling, in order that the sampling needle is not blocked or corroded by the acid.

A schematic of the system is shown in figure 1, and data from carbonate samples is shown in figure 2.

This data has been collected using the Sercon **smooth and simple** acid delivery system, combined with our continuous flow 20-22 IRMS.



Carbon

	NBS 18	$BaCO_3$	$LiCO_3$	Marble
	-5.30	-47.49	-46.59	2.35
	-5.18	-47.27	-46.54	2.42
	-5.22	-47.36	-46.63	2.48
	-5.20	-47.50	-46.45	2.36
	-5.01	-47.61	-46.52	2.39
SD 1σ ‰	0.10	0.13	0.07	0.05

Oxygen

	NBS 18	$BaCO_3$	$LiCO_3$	Marble
	6.78	14.44	3.85	28.45
	6.57	14.74	3.85	28.29
	7.01	14.45	3.68	28.42
	6.95	14.66	3.86	28.04
	7.04	14.79	3.73	28.43
SD 1σ ‰	0.19	0.16	0.08	0.17