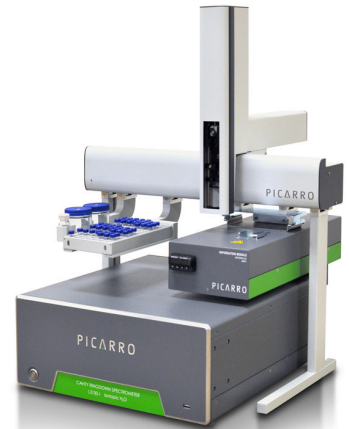


PICARRO L2130-*i* $\delta D/\delta^{18}O$ Ultra High-Precision Isotopic Water Analyzer

The quantum leap to per meg level precision

- One analyzer for solids, liquids, and vapor: lab precision and field robustness
- Typical precision of 11 per meg for $\delta^{18}O$ and 38 per meg for δD simultaneously for liquid samples
- Allan variance of 10's per meg for averaged $\delta^{18}O$ and δD vapor measurements
- Calibrate once per day while measuring with sub per mil certainty



Achieving high-precision measurements is critical for demanding applications such as paleoclimatology and oceanography yet very few laboratories and analytical techniques can reliably deliver a 1σ precision of < 25 per meg for $\delta^{18}O$ (1 per meg is 0.001 ‰). And almost no one has ever achieved a 1σ of < 100 per meg for δD . The L2130-*i* now makes such measurements accessible to all researchers. Figure 1 shows the sample to sample reproducibility achieved with a mere 6 measurements of a liquid sample. The typical value achieved is 11 per meg for $\delta^{18}O$ and 38 per meg for δD .

Equally important to precision is the stability of the analyzer. Figure 1 shows how stable the analyzer is for both isotopes. Over 24 hours the $\delta^{18}O$ the change is almost imperceptible, for δD there is a weak drift of ~200 per meg. Typical drift over 24 hours without recalibration is 82 per meg and 336 per meg for $\delta^{18}O$ and δD respectively. For applications with less stringent precision requirements the low level of drift eliminates the need for multiple calibrations, in fact the analyzer only requires calibration once a day for such cases. Alternatively this stability allows additional averaging to improve precision because drift does not offset the readings. Figure 2 shows precision as a function of number of measurements of the sample and shows precision of 0.020 for $\delta^{18}O$ can be achieved within 6 measurements.

The stability of the analyzer has an additional advantage for measurements requiring extreme precision such as continuous vaporization of ice core melt. The Allan variance essentially shows the precision as a function of averaging time shown in a log-log plot. In Figure 3 20 per meg was achieved for $\delta^{18}O$ within 1 minute and by 30 minutes an incredible precision of 5 per meg was reached. For δD 100 per meg was reached within 30 seconds for the same analyzer (Fig. 4).

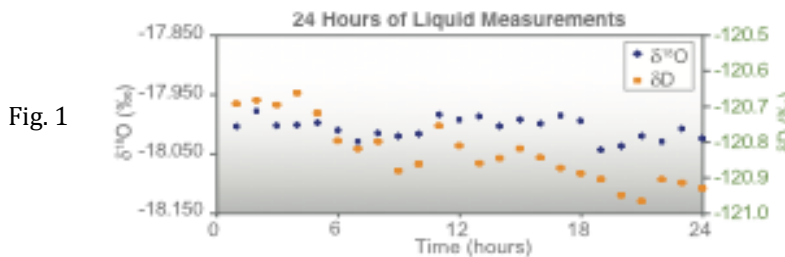


Fig. 1

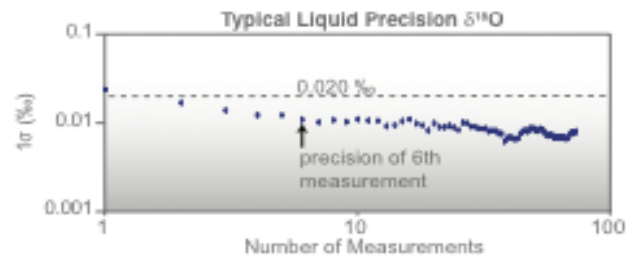


Fig. 2

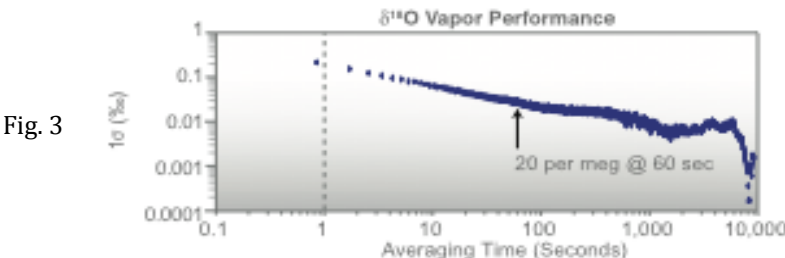


Fig. 3

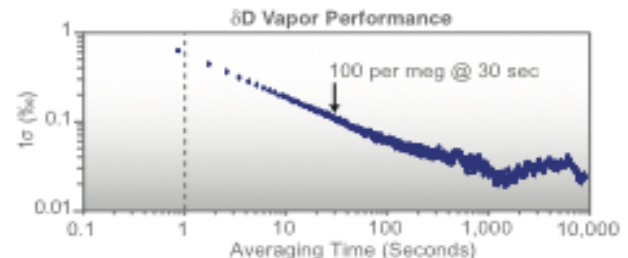


Fig. 4

Applications: Picarro's L2130-*i* provides a platform for advanced research into all aspects of the water cycle: water vapor, liquid water, or water trapped in solids. This field deployable analyzer has a full suite of accessories for preparation of the different sample forms to match your evolving research needs. And, like every Picarro analyzer it is tested against military shock and vibration standards to withstand the rigors of transport to field study sites.

For Solids: Our patent pending technology uses a combination of induction heating and dry gas to rapidly extract all the water from solids within minutes while concurrently sending the vapor directly to the analyzer. This breakthrough technology opens up an entirely new area of isotopic analysis due to its speed, ease-of-use, and high spatial resolution.

Accessories: Induction Module (A0213)

For Liquids: Samples from vials are automatically injected into a vaporizing unit held at high temperature and the resulting vapor sent to the analyzer. Polluted water and extracts from certain plants contain interfering organic compounds. The patent pending Micro-Pyrolysis Module breaks these down for maximum accuracy.

Accessories: Vaporizer A0211 for high-precision and saline water, Vaporizer A0212 for high-throughput fresh water, Autosampler A0325, Micro-Pyrolysis Module A0214

For Vapor: Rugged design, temperature and pressure control, and manageable weight differentiate CRDS based analyzers from any other technology for field studies. Automated delivery of multiple standards and vapor source multiplexing can be done from one interface to simplify vapor studies including evapotranspiration.

Accessories: Standards Delivery Module A0101, Vaporizer A0211

**specifications are tested for each unit and based on specific accessories. Please contact Picarro to learn more about the rigorous testing process and application specific accessories.*

Typical performance specifications are based on the average results of all units manufactured to date.

Solid Specifications*	
Precision (1 σ)	Guaranteed: 0.35 / 1.50 ‰ for $\delta^{18}\text{O}$ / δD Typical: 0.25 / 1.20 ‰ for $\delta^{18}\text{O}$ / δD
Throughput	3 to 20 minutes depending upon sample

Liquid Specifications*	
Precision (1 σ)	Guaranteed: 0.03 / 0.2 ‰ for $\delta^{18}\text{O}$ / δD Typical: 0.011 / 0.038 ‰ for $\delta^{18}\text{O}$ / δD
Maximum 24 hour Drift	Guaranteed: 0.200 / 0.800 ‰ for $\delta^{18}\text{O}$ / δD Typical: 0.082 / 0.336 ‰ for $\delta^{18}\text{O}$ / δD
Throughput	12 to 54 minutes per sample depending upon vaporizer model and mode
Memory	Guaranteed 99 / 98 % for $\delta^{18}\text{O}$ / δD
Total Dissolved Solids	< 20 % for A0211, < 4 % for A0212 vaporizer model

Vapor Specifications*	
Measurement range	1,000 to 50,000 ppm
Guaranteed Precision (1 σ) 2,500 ppm	0.250 / 0.080 ‰ for $\delta^{18}\text{O}$ for 10 / 100 sec 1.600 / 0.500 ‰ for δD for 10 / 100 sec
Guaranteed Precision (1 σ) 12,500 ppm	0.120 / 0.040 ‰ for $\delta^{18}\text{O}$ for 10 / 100 sec 0.300 / 0.100 ‰ for δD for 10 / 100 sec
Typical Precision (1 σ) 12,500 ppm	0.120 / 0.019 ‰ for $\delta^{18}\text{O}$ for 10 / 100 sec 0.158 / 0.050 ‰ for δD for 10 / 100 sec
Measurement Rate	> 1Hz

Analyzer Specifications	
Measurement Technique	CRDS
Temperature	-10 to 45°C (vapor sample), 10 to 35 °C (liquid sample & system operation) -10 to 50 °C (storage)
Sample Pressure	300 to 1000 Torr (40 to 133 kPa)
Sample Flow Rate	~ 40 sccm at 760 Torr, no filtration required
Installation	Benchtop or 19" rack mount
Analyzer Dimensions	17" w x 7.5" h x 17" d (43.2 cm x 19.1 cm x 43.2 cm)
Analyzer Weight	45 lbs (20.4 kg)
Power	90-240 VAC, 50/60 Hz, < 200 W steady state