



Performance of the Picarro CRDS
water isotope analyzer
for $\delta^2\text{H}$ tracer studies

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Analytical challenges in $\delta^2\text{H}$ tracer studies using optical spectroscopy

Analytical challenges:

1. Memory effect
2. Spectroscopic limits

Study goals:

Test the performance of the L2130-*i* analyzer for a set of water samples with varying $^2\text{H}/^1\text{H}$ ratios of 0.1 to 2.0% (corresponding to $\delta^2\text{H}$ values of about 6,000 to 130,000‰):

- Characterize memory effect using the new Express mode (faster memory removal)
- Review spectroscopic limits

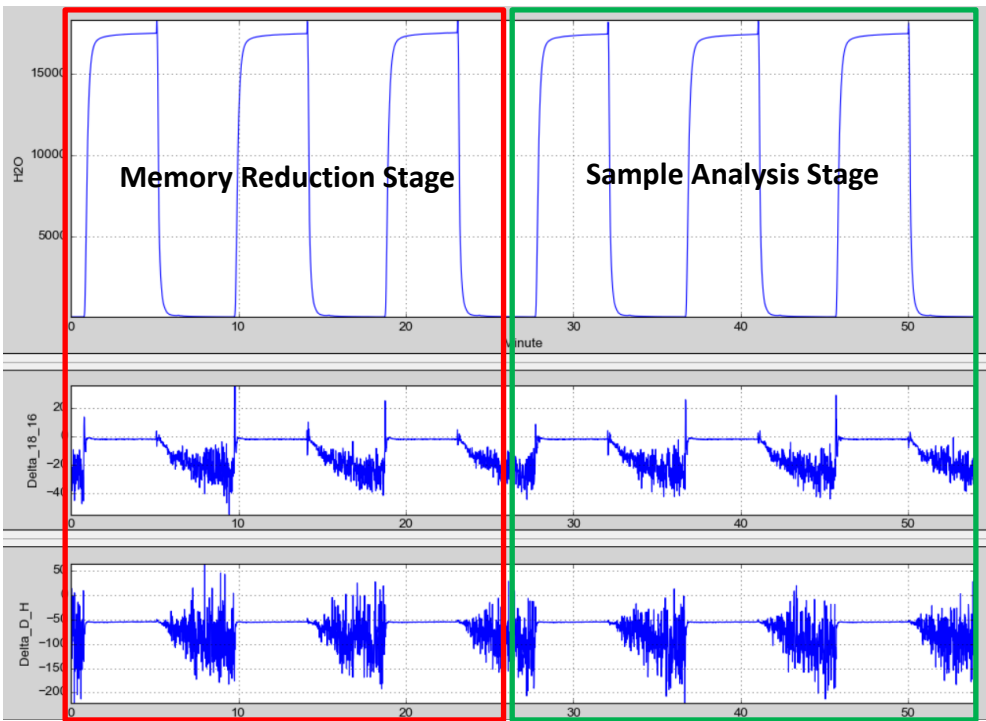


Picarro water isotope analyzers (L2130-*i*, L2140-*i*) are leading work-horse solutions for flexible $\delta^{18}\text{O}$, $\delta^2\text{H}$ and ^{17}O -excess measurements.

Picarro Express mode: faster memory removal

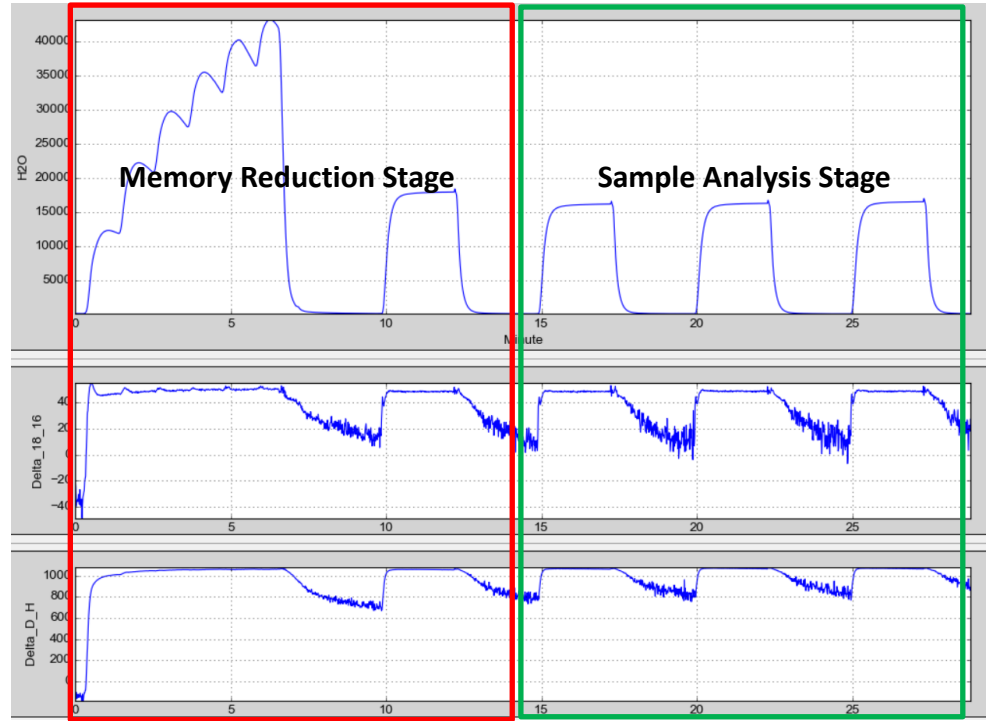
- The Picarro standard protocol for natural abundance waters is to run 6 injections and use only 3 for data collection. The new method also includes only 3 injections in the “sample-analysis” stage.

Picarro Standard Mode



← 54 min →

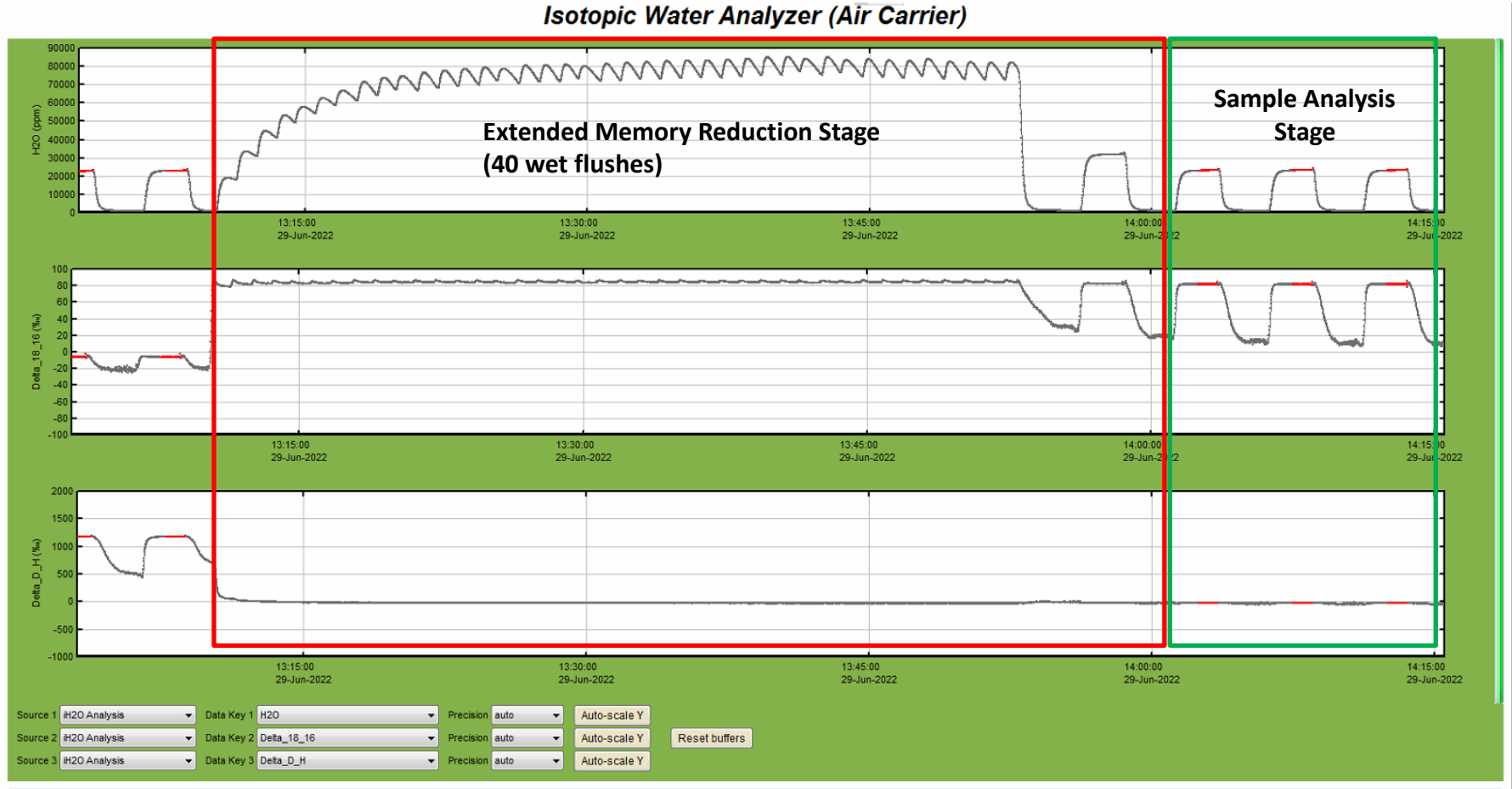
Picarro Express Mode



← 29 min →

Adjusted Picarro Express mode for $\delta^2\text{H}$ tracer studies

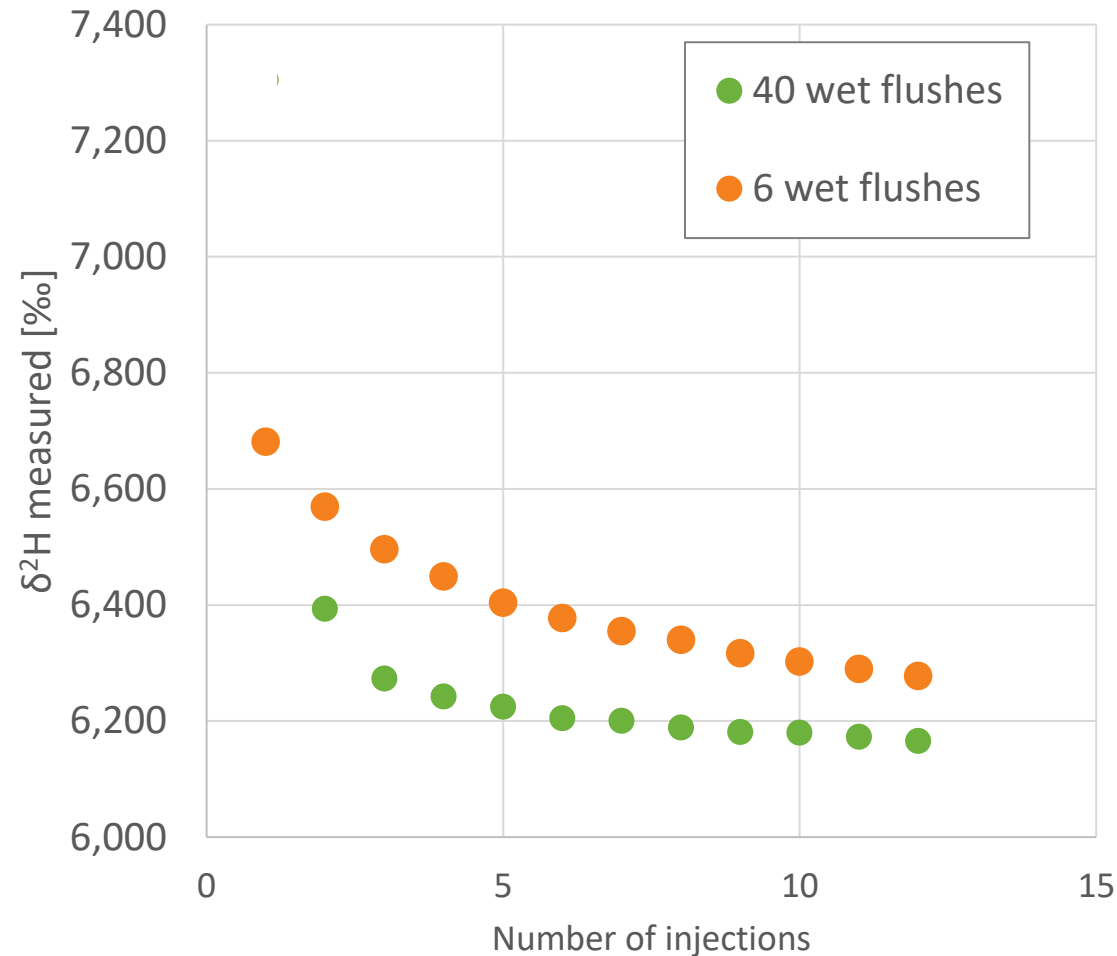
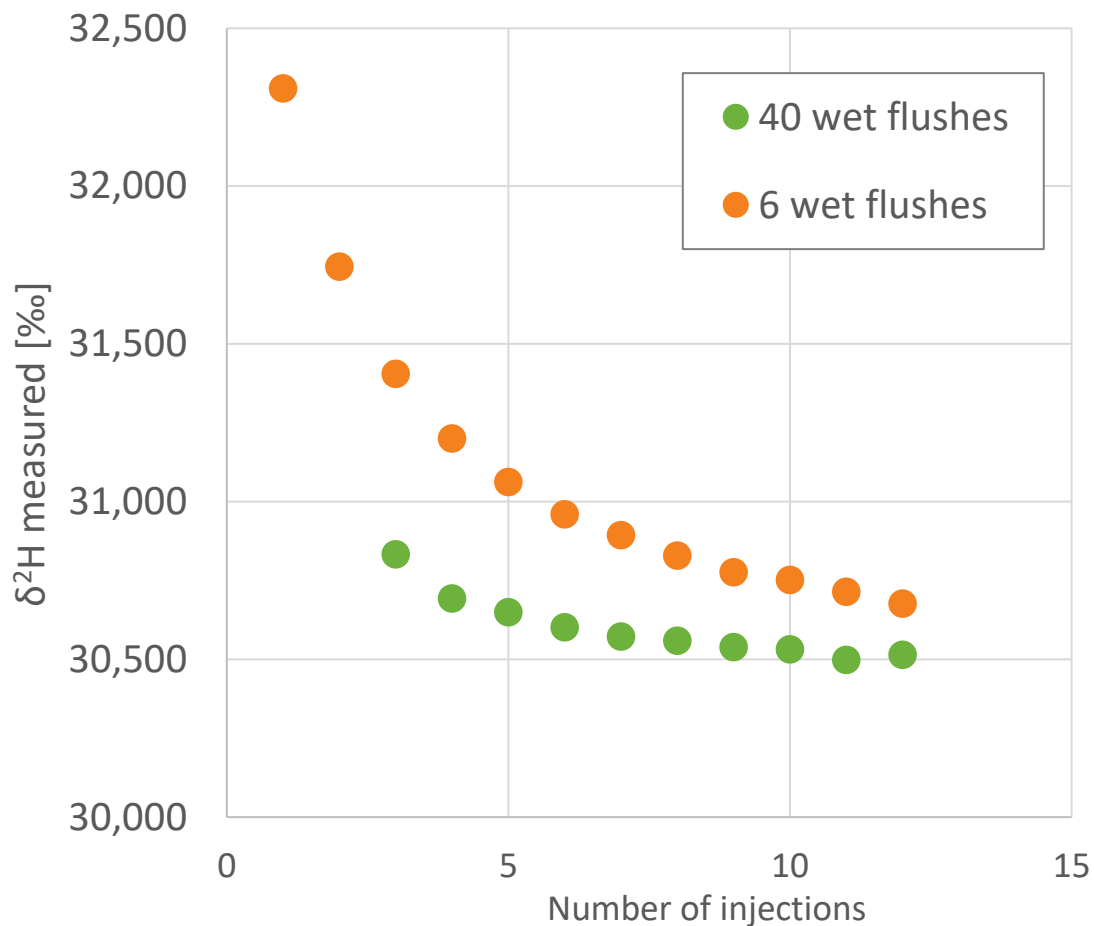
- The number of wet flushes can be modified to improve memory removal for highly enriched samples.



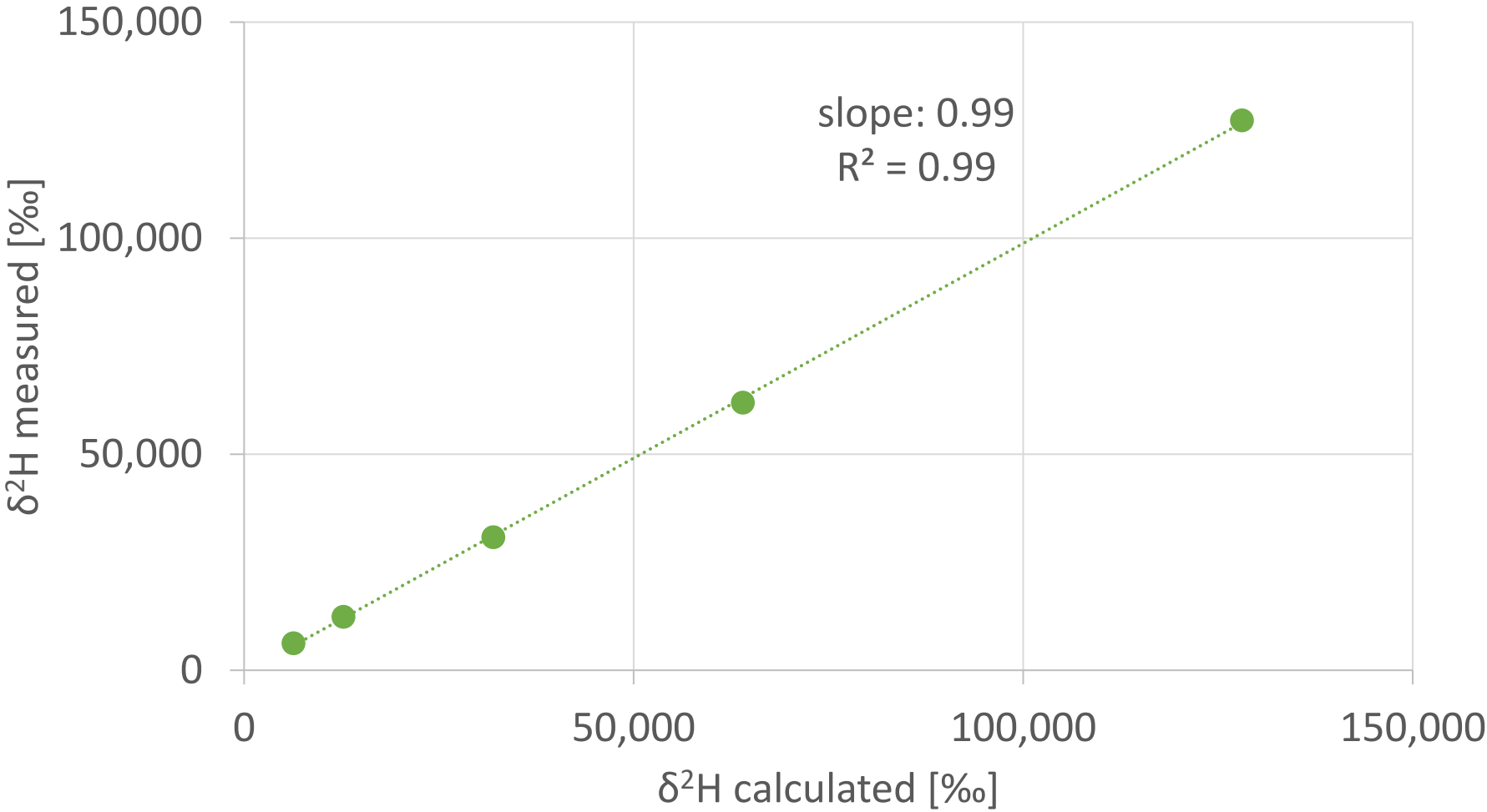
← ~50 min →

Memory removal: 40 vs. 6 wet flushes

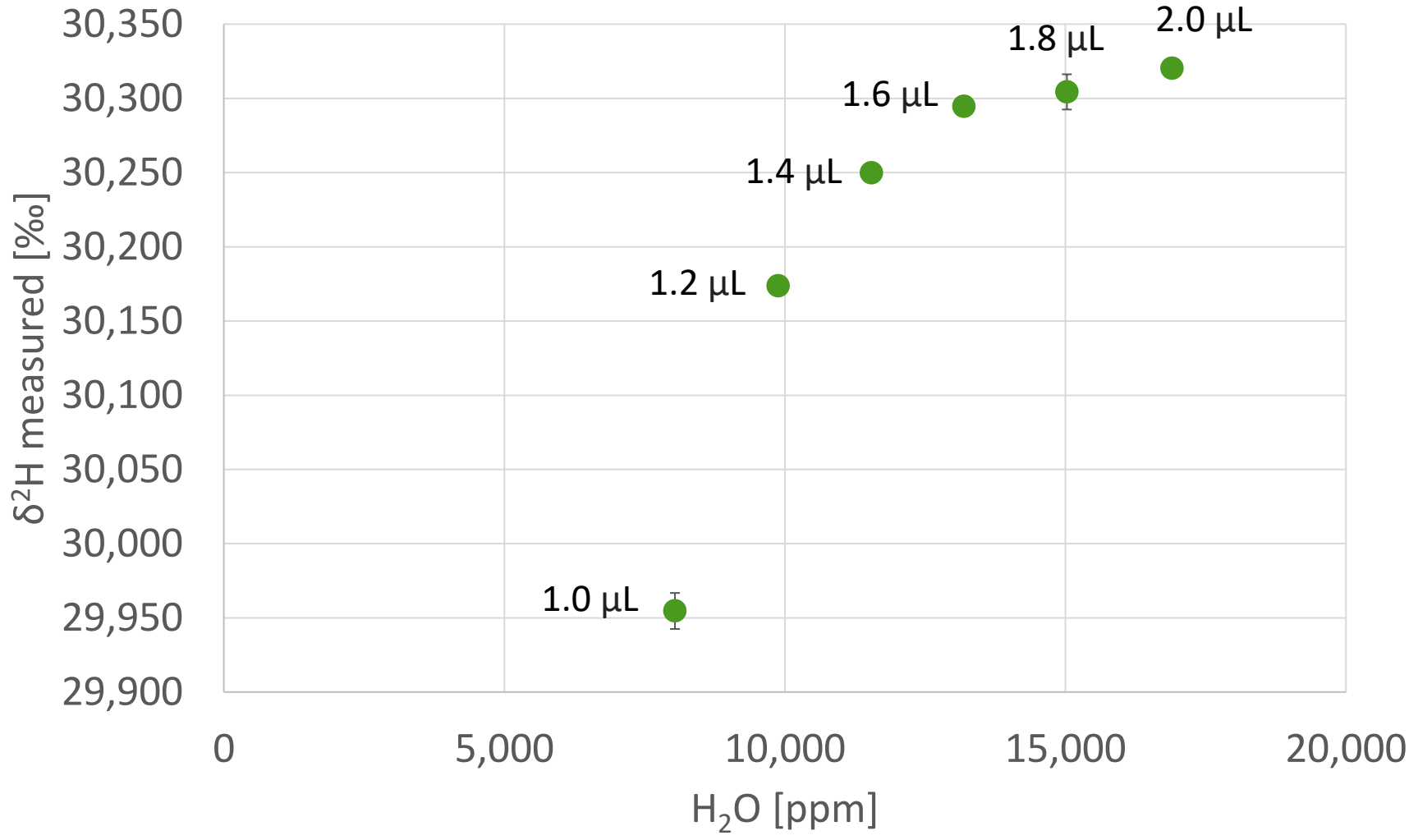
- Increasing the number of wet flushes decreases the memory effect significantly.



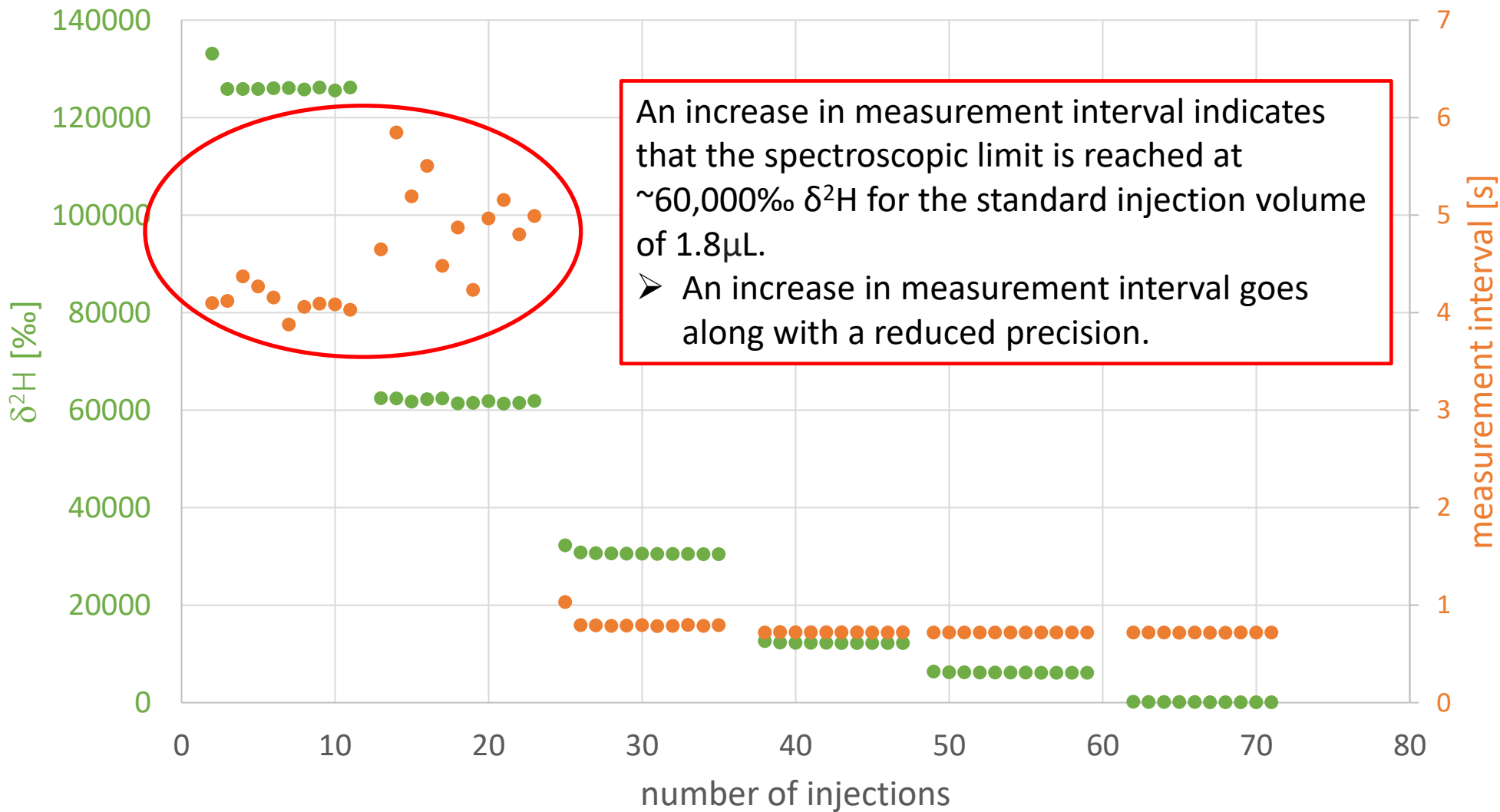
Excellent linearity



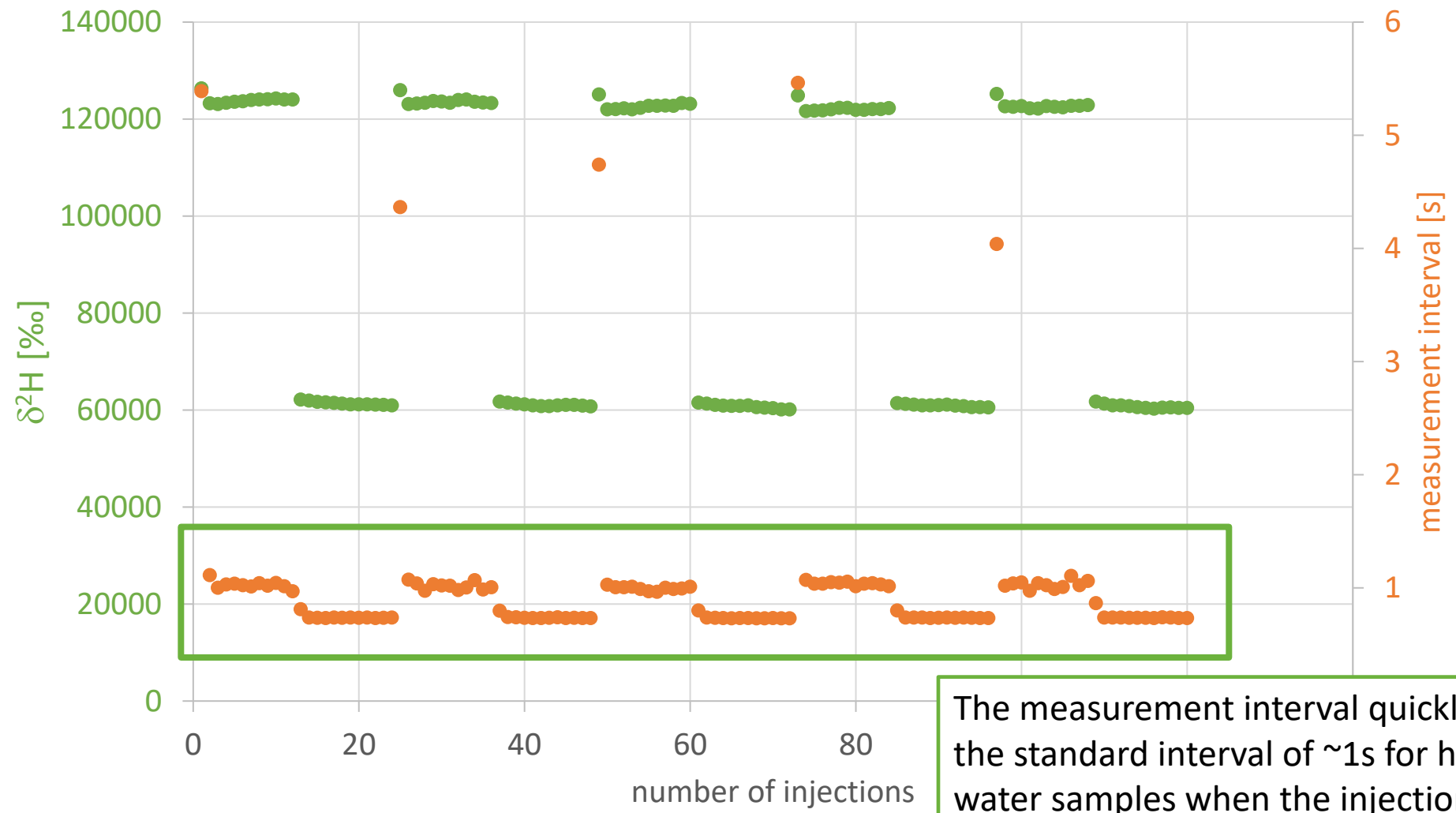
Negligible concentration dependence



Spectroscopic limit (1.8 μL injection volume)

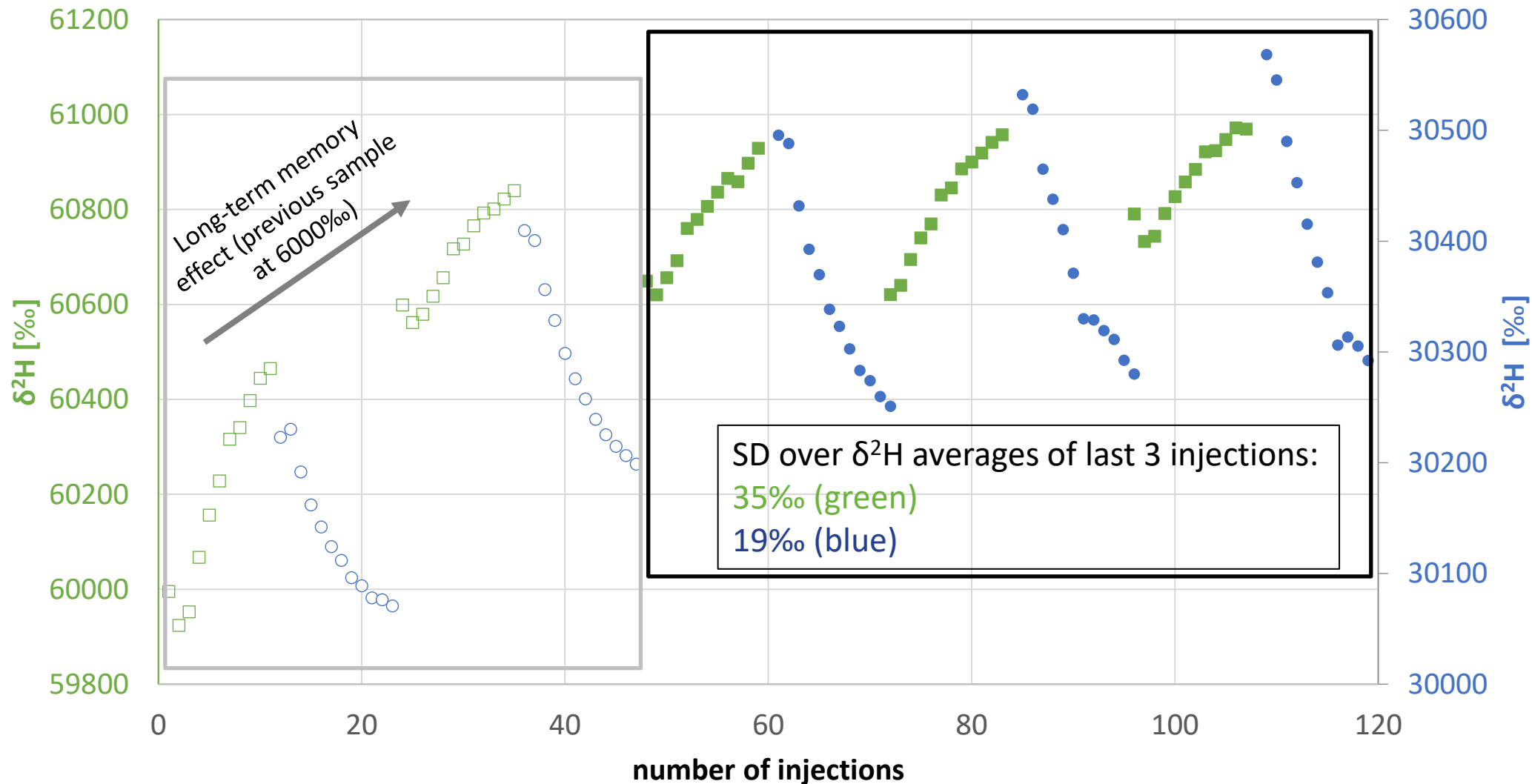


Extended spectroscopic limit (0.8 μL injection volume)



The measurement interval quickly stabilizes at the standard interval of $\sim 1\text{s}$ for highly enriched water samples when the injection volume is reduced to $0.8 \mu\text{L}$.

Reproducibility test



Conclusions

- Reduced memory effect when using the new Express mode.
- Excellent linearity over a high $\delta^2\text{H}$ enrichment range (up to 130,000‰).
- Negligible concentration dependence at high enrichment levels.
- Reduction in injection volume (<1.8 μL) beneficial to avoid measurement gaps at high enrichment levels.
- It is recommended to keep samples at a similar enrichment level within one sequence to avoid long-term memory effects.
- The analyzer should be calibrated with appropriate standards.

SPEAKER



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