Calibration methods for atmospheric mercury concentrations

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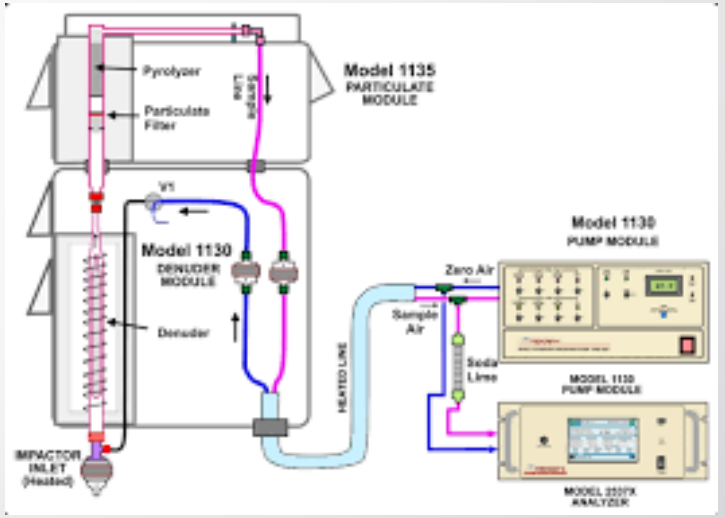
Mercury in the atmosphere



- Mercury fractions:
  - Total gaseous mercury, TGM
  - Gaseous elemental mercury, GOM
  - Gaseous oxidized mercury, GOM
  - Particulate-bound mercury, PBM
- Calibration issues
  - Calibration usually using Hg(0) for all Hg fractions
- Requirements for species-specific Hg calibrations

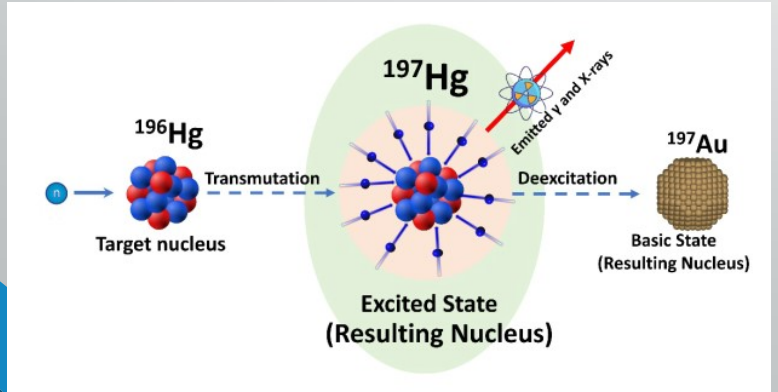
Calibration capability

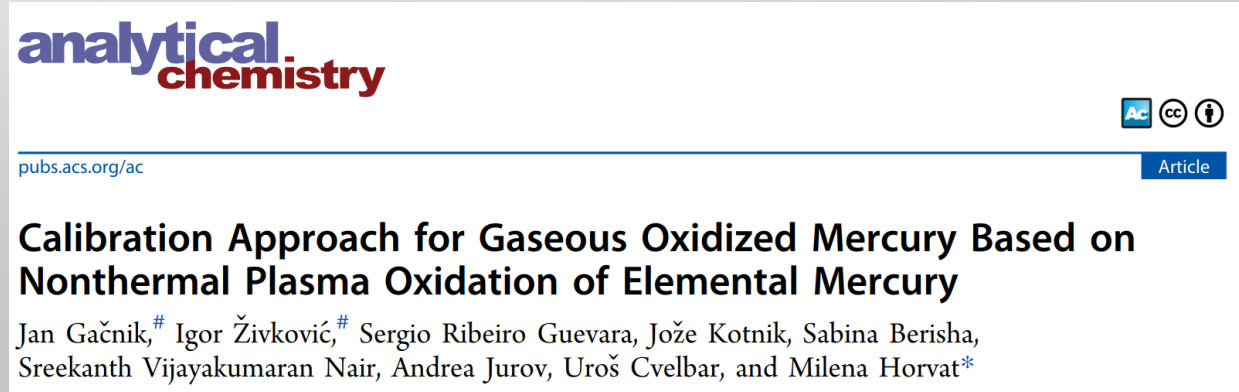
- For high concentrations
- For GEM
- Validation of calibration strategies

- For low concentrations
- For GOM
- Recent developments

1. Calibration Approach for GOM Based on Nonthermal Plasma Oxidation

- Helium (cold) plasma
- Energy in energetic electrons vs. energy converted into heat
- Quantitative conversion of Hg(0) to Hg(II)
- Use of reactive gasses (O2, Cl2, Br2) for the production of HgO, HgCl2, HgBr2
- Validated using radioactive ^{197}Hg tracer




analytical chemistry

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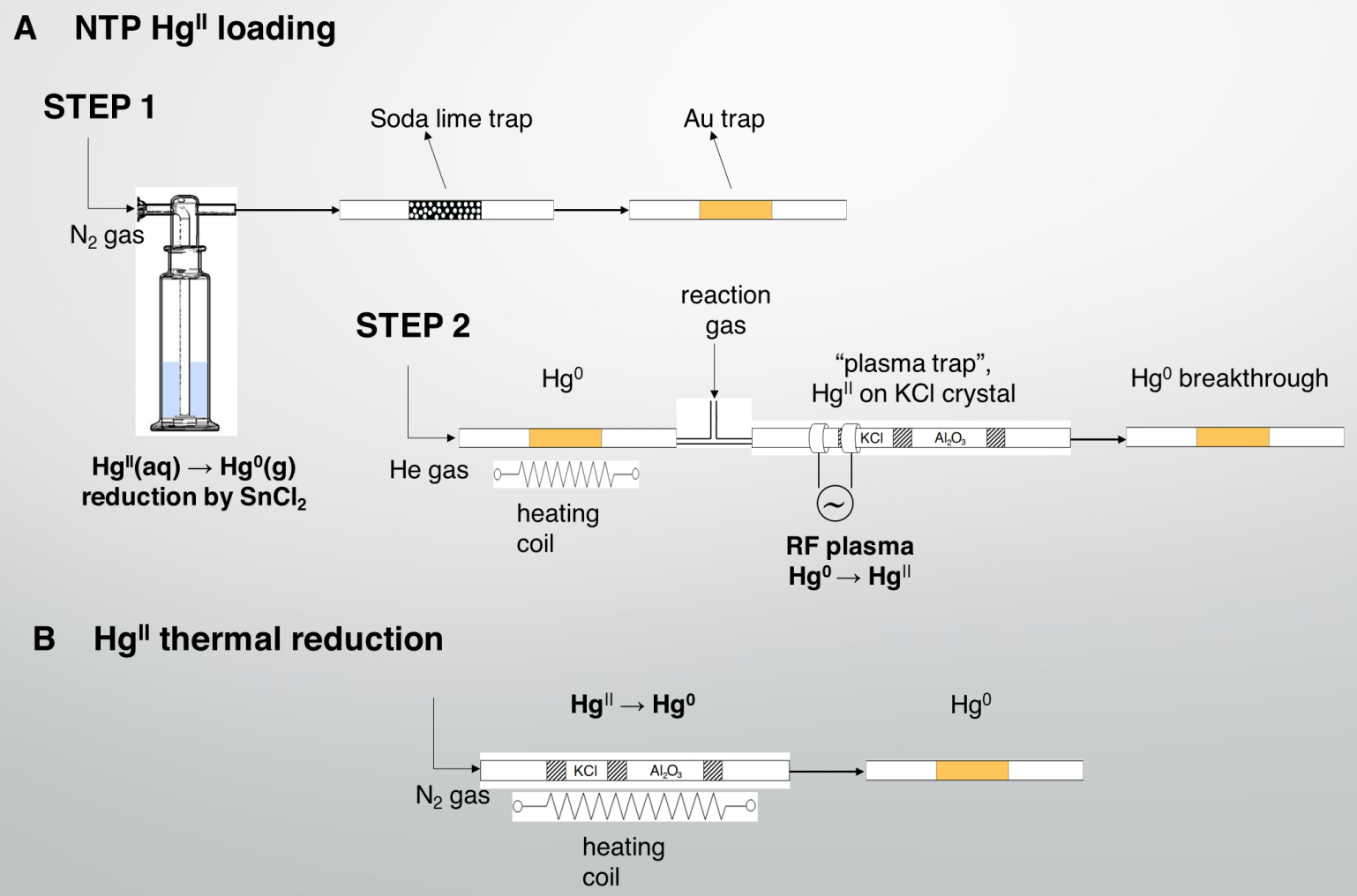
Article

Calibration Approach for Gaseous Oxidized Mercury Based on Nonthermal Plasma Oxidation of Elemental Mercury

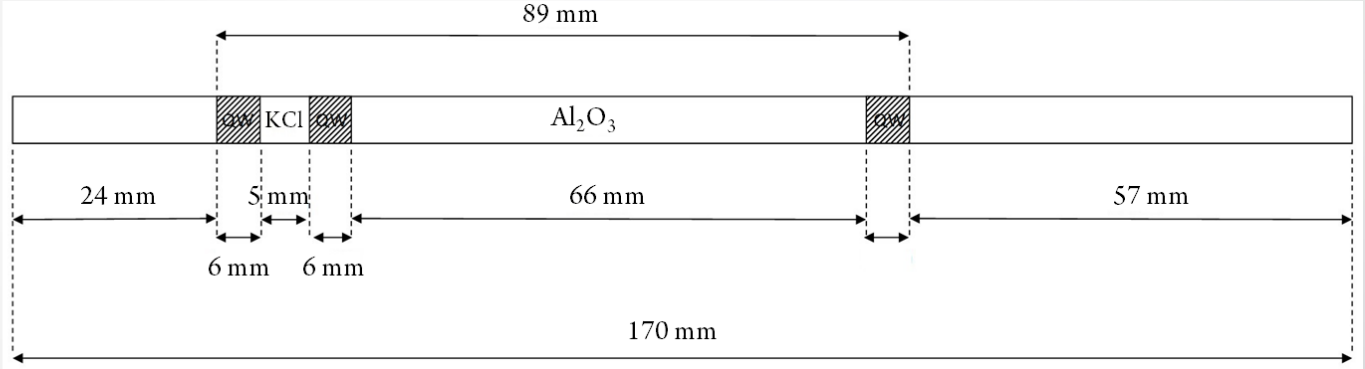
Jan Gačnik,[#] Igor Živković,[#] Sergio Ribeiro Guevara, Jože Kotnik, Sabina Berisha, Sreekanth Vijayakumaran Nair, Andrea Jurov, Uroš Cvelbar, and Milena Horvat*

1. Calibration Approach for GOM Based on Nonthermal Plasma Oxidation



1. Calibration Approach for GOM Based on Nonthermal Plasma Oxidation

- Design of the thermal reduction tube

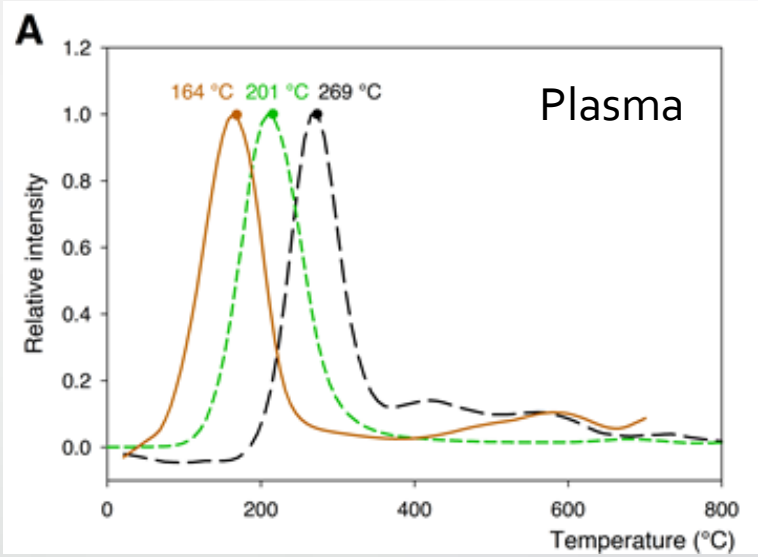


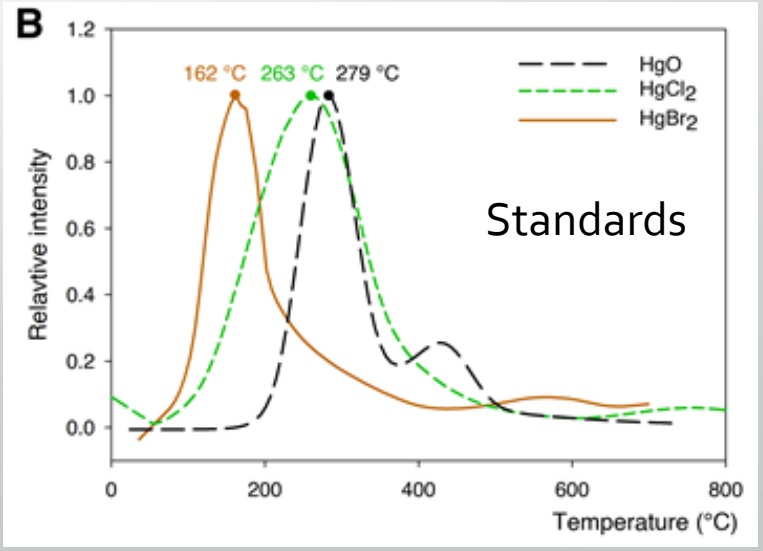
Hg^{II} to Hg^0 thermal reduction, Hg^{II} loaded by spiking

Catalyst used	Hg^0 [%]	Unconverted Hg^{II} [%]	Mass balance [%]
None	88 (26)	25.6 (43)	113 (22)
Au-coated silica	38 (3)	61 (5)	99 (2)
Pt wire	39 (28)	49 (32)	88 (5)
Quartz wool	86 (19)	15 (12)	101 (8)
Al_2O_3	101 (3)	<0.1	101 (3)

1. Calibration Approach for GOM Based on Nonthermal Plasma Oxidation

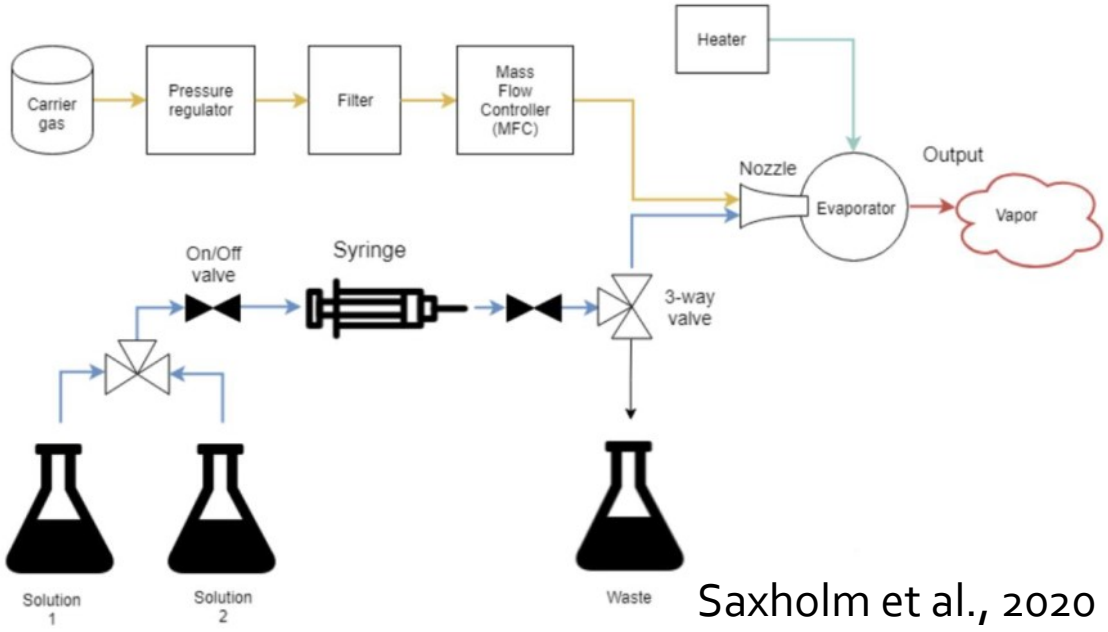
- Identification of Hg(II) species
  - TPD-QMS





2. Validating an Evaporative Calibrator for Gaseous Oxidized Mercury

- GOM calibration system Optoseven
- Validated at high levels
- Behavior at ng/m^3 level?



Saxholm et al., 2020

sensors

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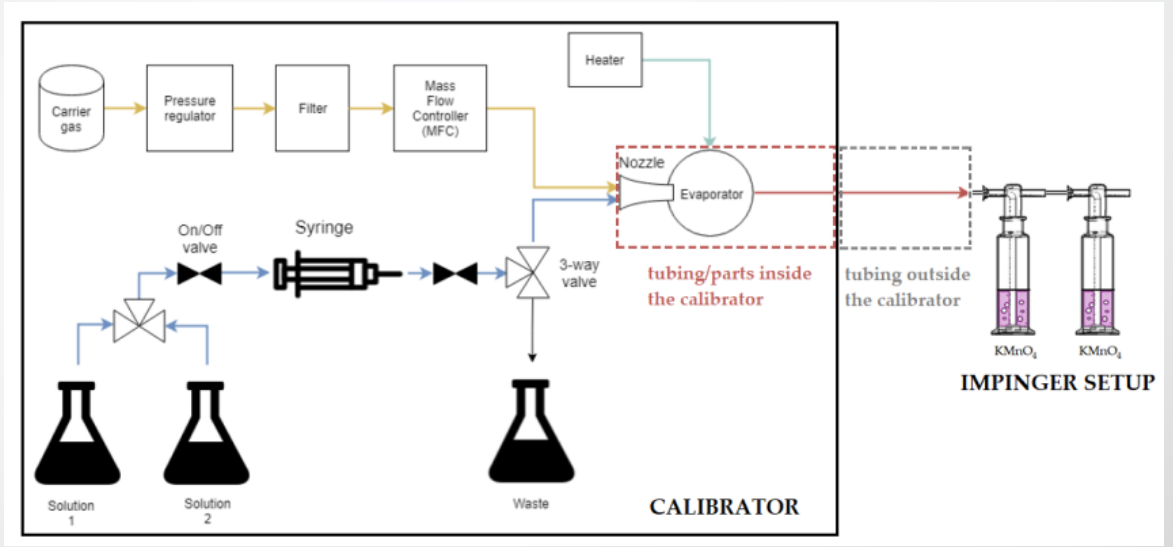
Article

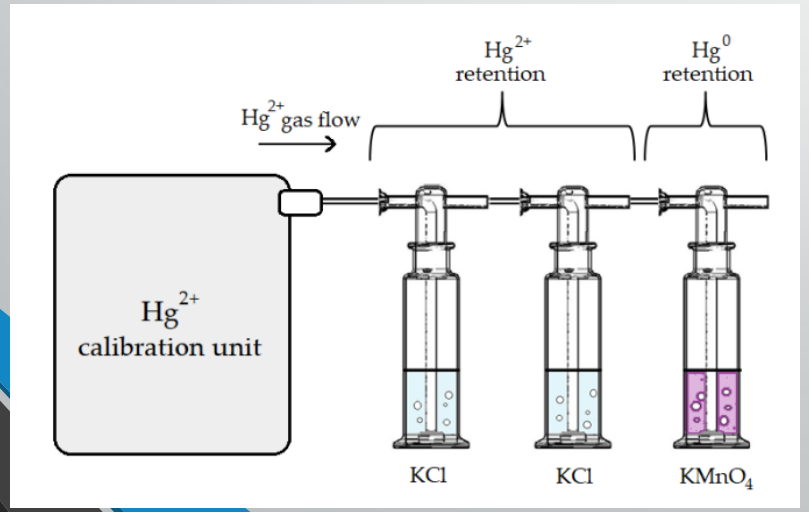
Validating an Evaporative Calibrator for Gaseous Oxidized Mercury

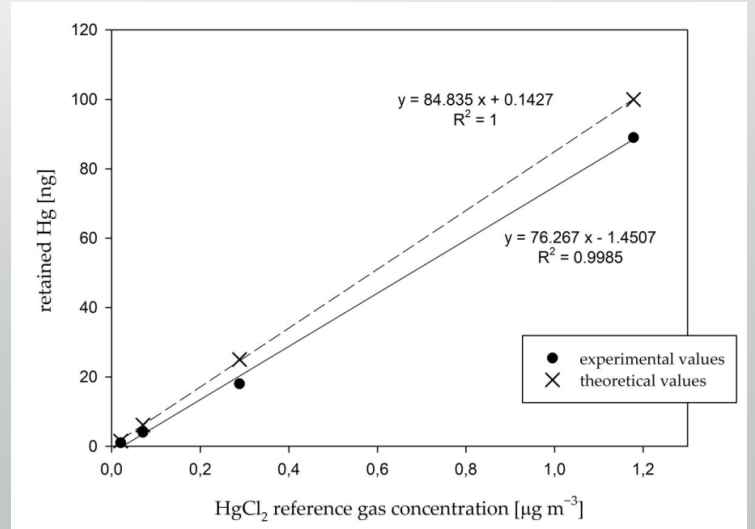
Jan Gačnik [1,2], Igor Živković [2], Sergio Ribeiro Guevara [3], Radojko Jaćimović [2], Jože Kotnik [2] and Milena Horvat [1,2,*]

2. Validating an Evaporative Calibrator for Gaseous Oxidized Mercury

- Experimental setups
- Flow resistance!







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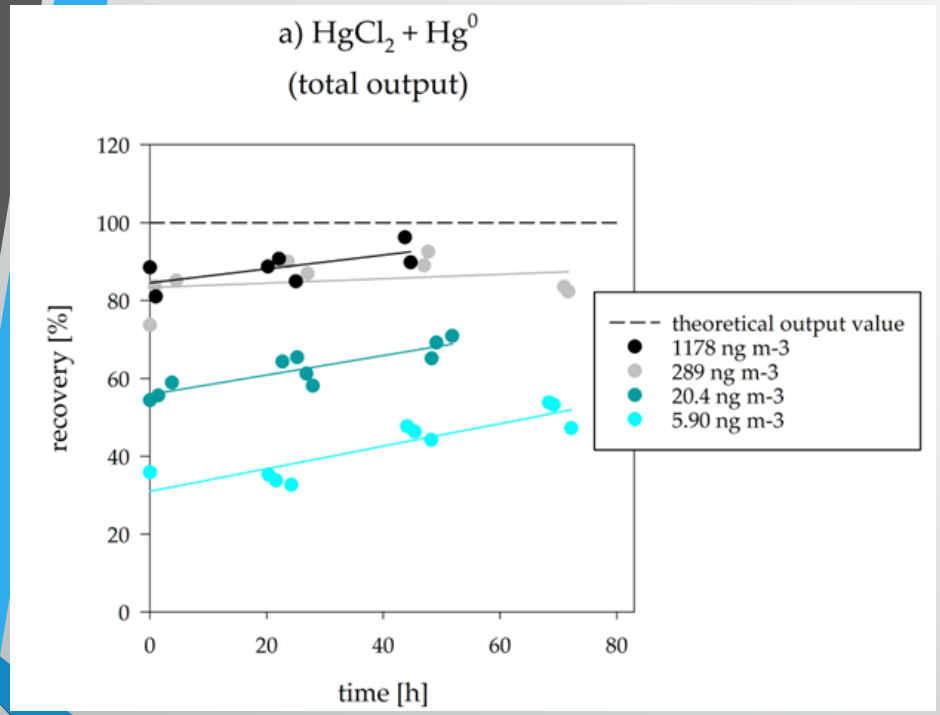

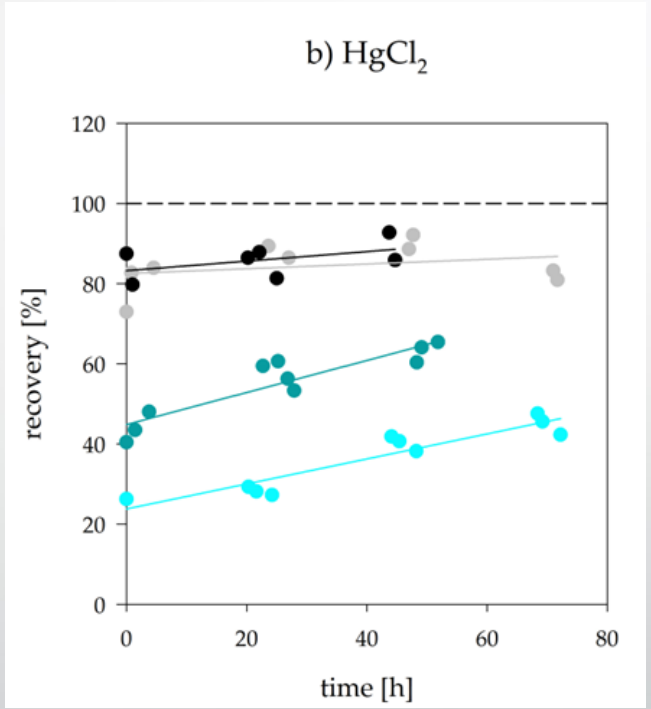

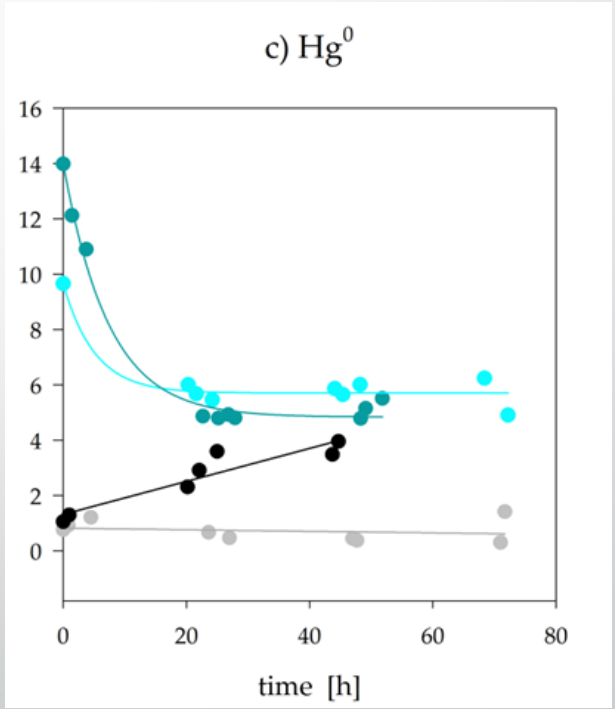

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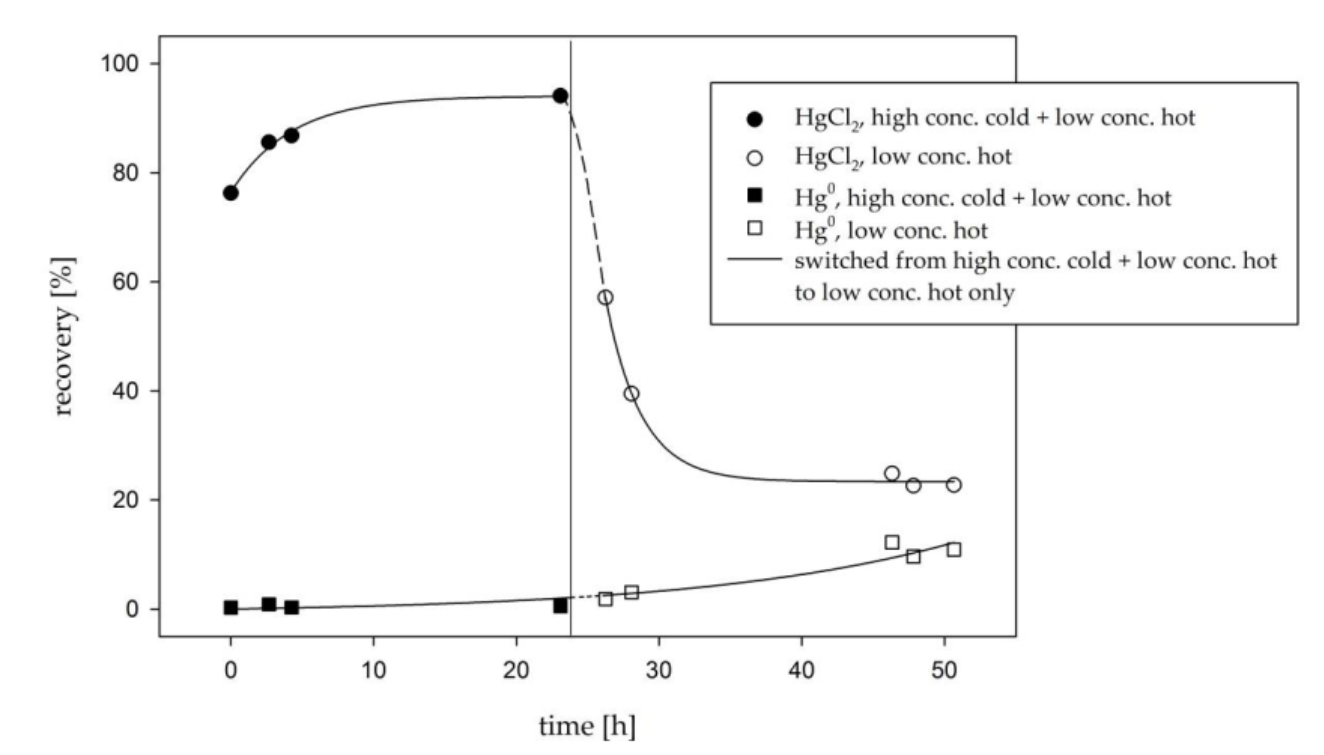

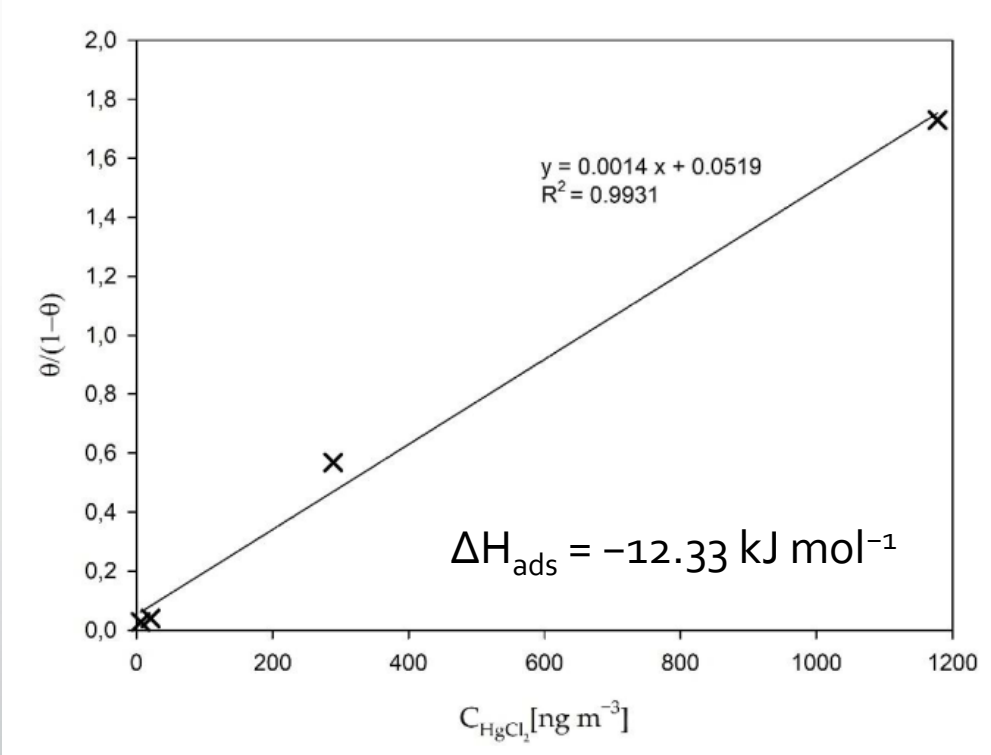

Take away message

- Still a lot of work to be done to properly measure low atmospheric Hg levels