



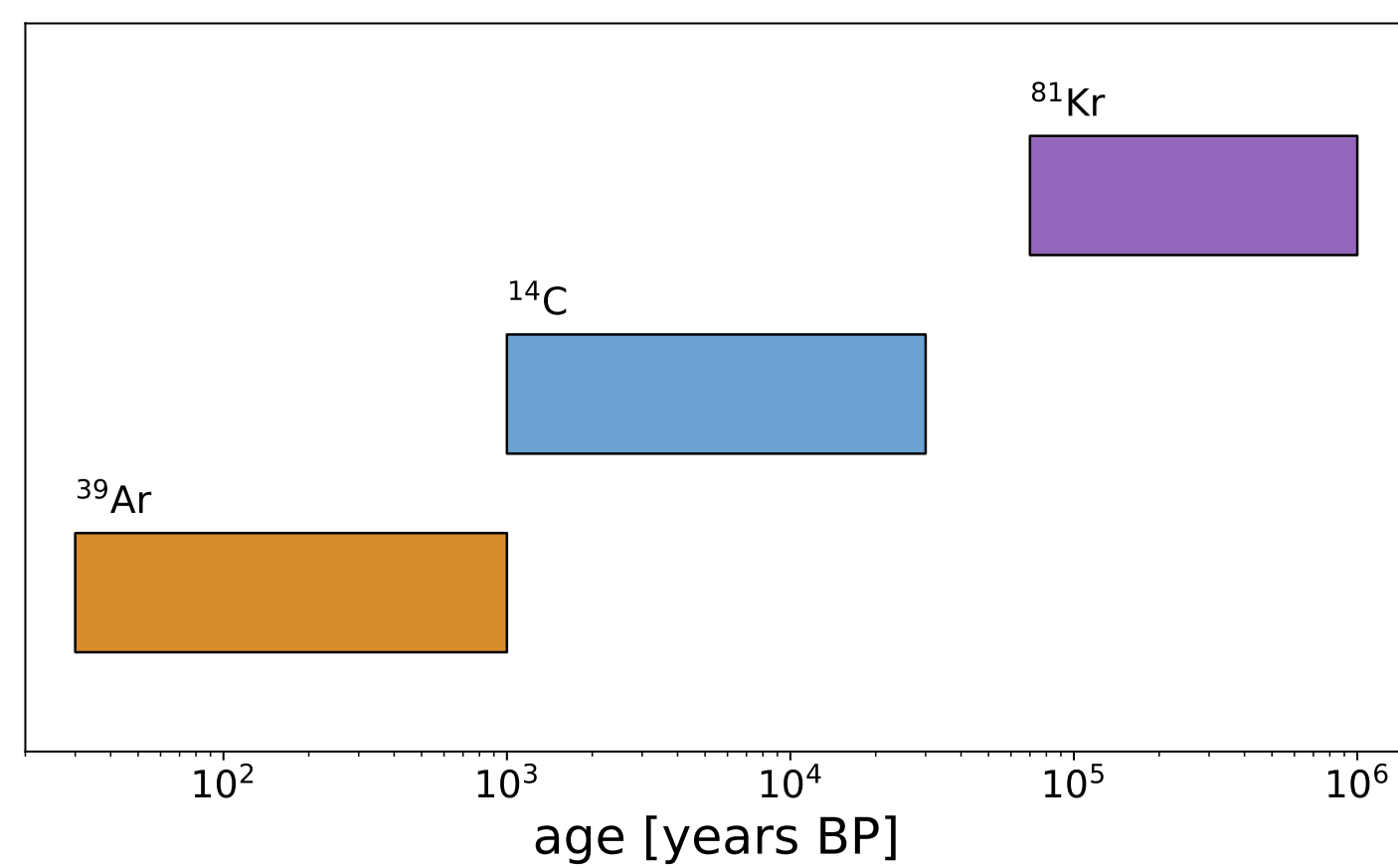
PO14C dating of glacier ice - Recent improvements for an easier device handling

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PO14C Dating Basics

- Radioactive age tracer ^{14}C
 $T_{1/2} = 5730 \pm 40$ years
Dating range:



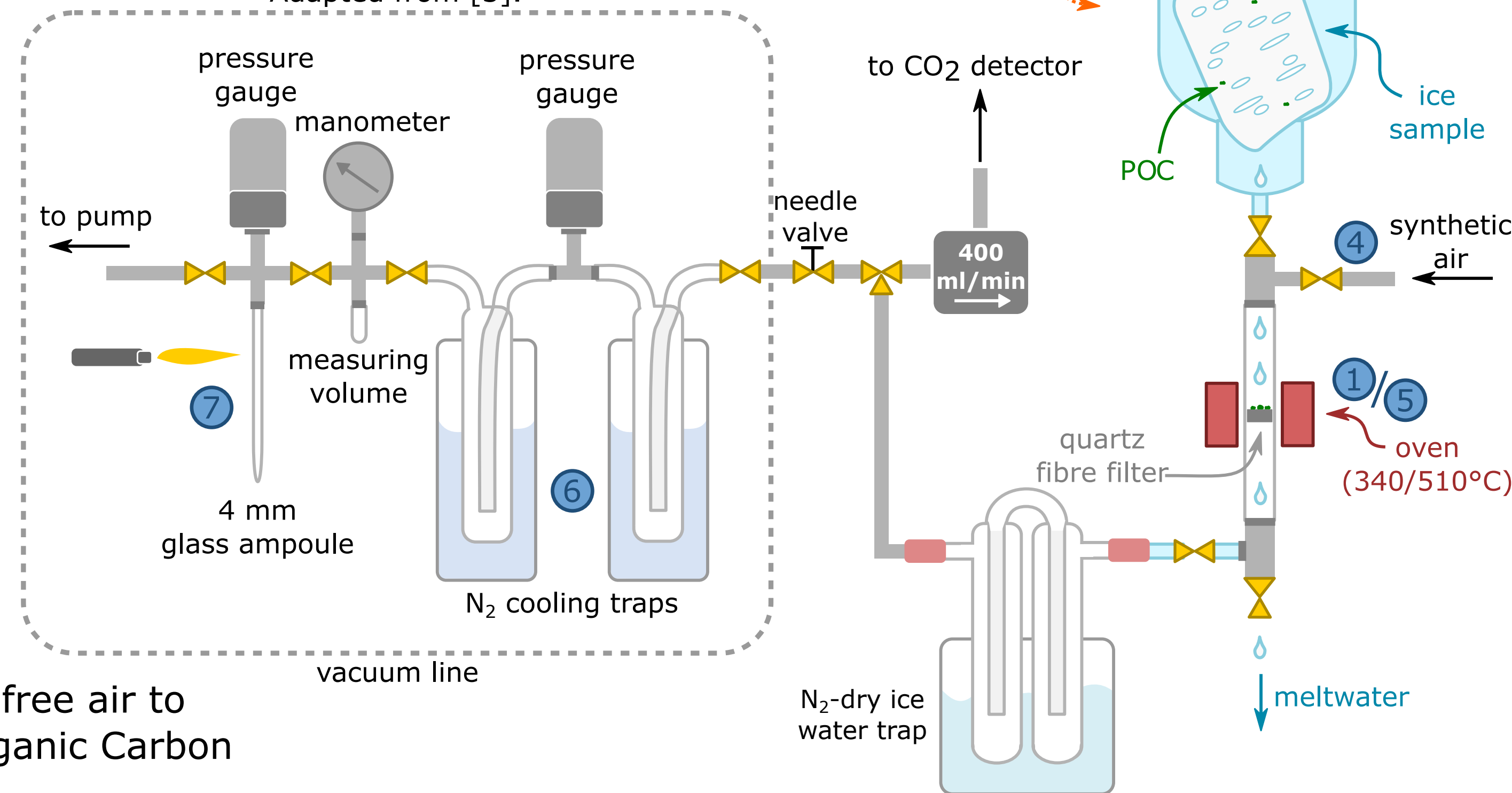
- Radiocarbon analysis performed at Accelerator Mass Spectrometer (AMS) at Curt-Engelhorn-Center Archaeometry (CEZA Mannheim, Germany)

- Particulate organic aerosols are trapped in precipitation, deposited on glacier and finally trapped in ice-matrix
→ Particulate Organic Carbon (POC) is used for PO14C dating since ~20 years [1,2]

Measurement Process:

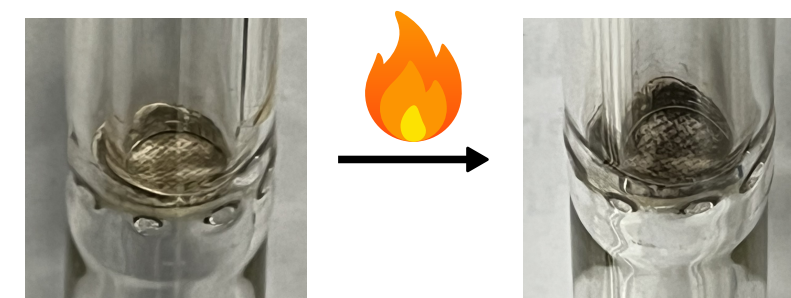
1. Cleaning of setup + Preheating quartz filter
2. Melting of ice → POC collected on quartz filter
3. Oxidation with HCl to degas Inorganic Carbon

Fig. 1: Overview of the extraction and cleaning system. Adapted from [3].



4. Purging CO₂-free air to remove Inorganic Carbon

5. Combustion of POC to CO₂ at 340°C



6. Isolation of CO₂ gas in vacuum line

7. Flame sealing sample in glass ampoule

8. Measurement of ^{14}C with AMS equipped with gas inlet at CEZA (>3μgC required)

Improved Combustion Chamber

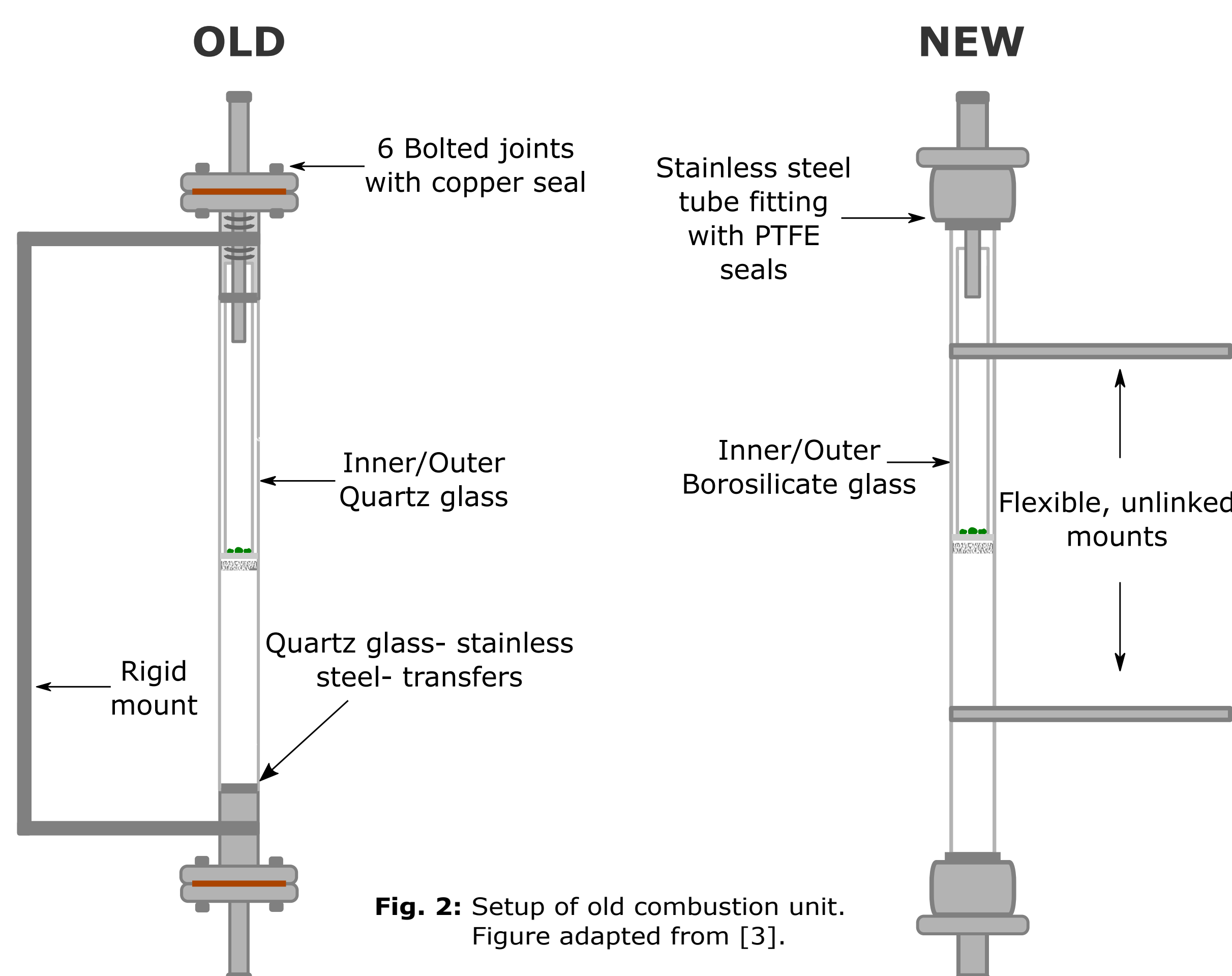


Fig. 2: Setup of old combustion unit. Figure adapted from [3].

Advantages of new system:

- Better cleaning due to removable glass tube
- No more rigid mount (less shear stress on glass)
- Cheaper + better/faster availability of parts

However:

- No more Quartz glass → Preheating for filter & device cleaning lowered from 900°C to 510°C
- Use of PTFE seals → Potential contamination?

→ Can the mandatory low process blanks be maintained?

First Performance Tests

- No performance loss compared to original setup
- Ultra pure water blank values: <0.03 μgC
- Filtration efficiency: 99%
- Standard material tests show good accordance with nominal values:

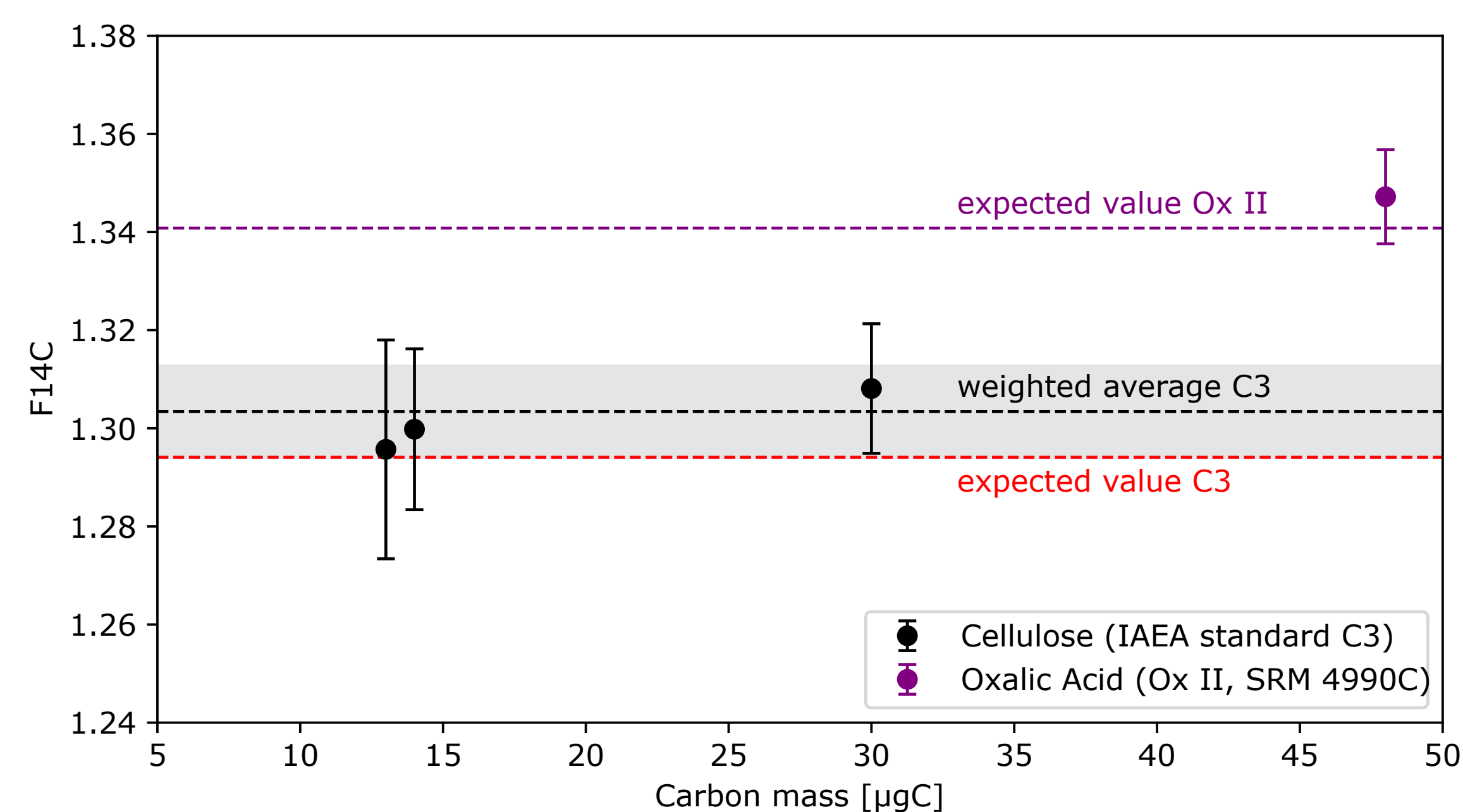


Fig. 3: Standard measurements with the new combustion chamber. Error bars show 1σ uncertainties.

Application on Alpine Ice Cores

Weißseespitze glacier in Austria

- Height: 3500 m a.s.l.
- 2019 ice core ^{14}C -dated at Paul-Scherrer Institute (PSI) [4]
- 2025 more ice cores were drilled at same site
- First comparison of ^{14}C dating at PSI & IUP:

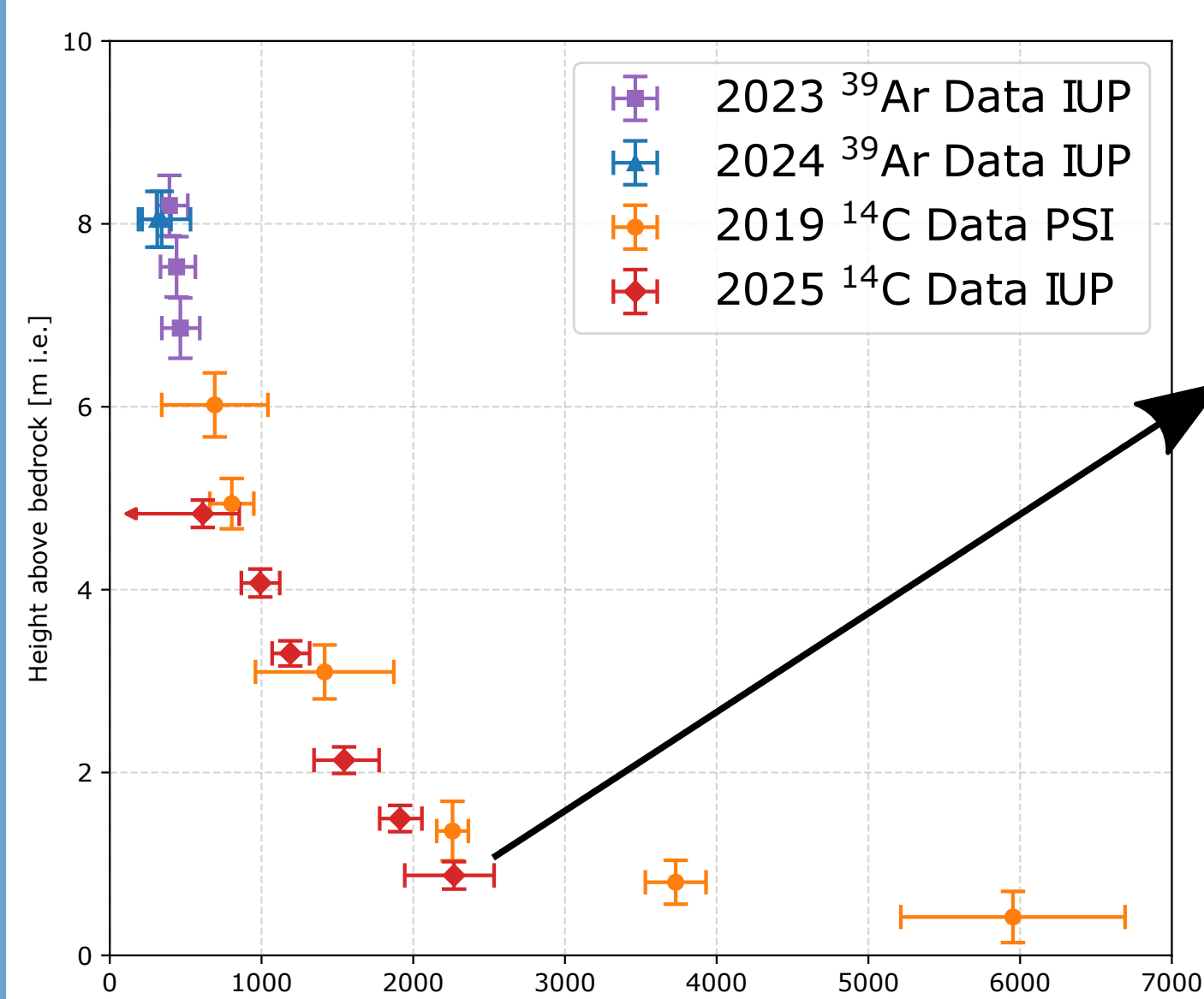
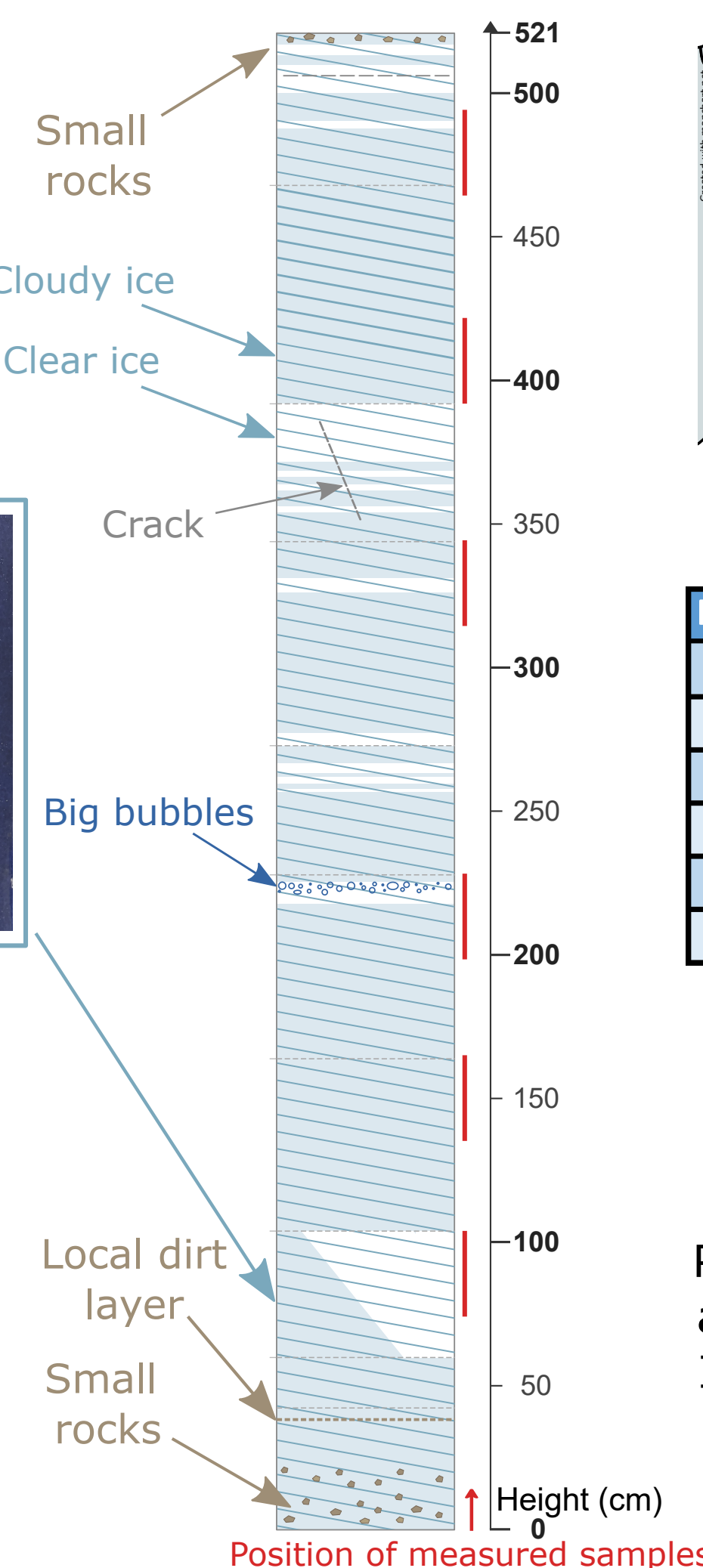


Fig. 4: ^{39}Ar and ^{14}C age data plotted against height above bedrock (m i.e.). ^{39}Ar and 2019 ^{14}C data is adapted from [4]. New IUP ^{14}C data is highlighted in red. Error bars show 1σ uncertainties.

? Run8 is younger than expected!
Vertical melt layer across most of the run (bubbles only at left edge)
→ Younger material reached deeper layers?

Spatial deviation of drilling sites up to 10m
→ Bedrock roughness can vary up to 2m!

Within the uncertainties:
It's a match!



POC extracted from 2025 WSS core

Run	Height above bedrock [cm]	Ice mass [kg]	POC [μg]
1	483	317	8
2	407.25	354	42
4	330.25	288	61
6	213.5	409	10
7	149.65	368	21
8	87.5	435	9

POC Combustion Yield

IUP 2025: 21-212 μgC/kg ice
PSI 2019: 41-428 μgC/kg ice [5]

Combustion System

PSI: SUNSET system (thermo-optical OC/EC analyzer) including combustion at 375°C [6]
IUP: 1-step inline combustion at 340°C [2,3]

→ Lower yield at IUP, but well comparable ^{14}C results

Outlook

1. Start routine analysis of non-polar glacier samples
2. Setup of an external pre-filtration unit

↓
Enables analysis of debris-rich samples (e.g. rock glaciers)



Abstract/OSPP voting form



References

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