



# A Specialized Desolvating Nebulizer and Washout System for U-Series Dating with Multicollector ICP-MS

Fred G. Smith<sup>1</sup>, Peter Winship<sup>2</sup>, Chad Paton & Martin Bizarro<sup>3</sup>

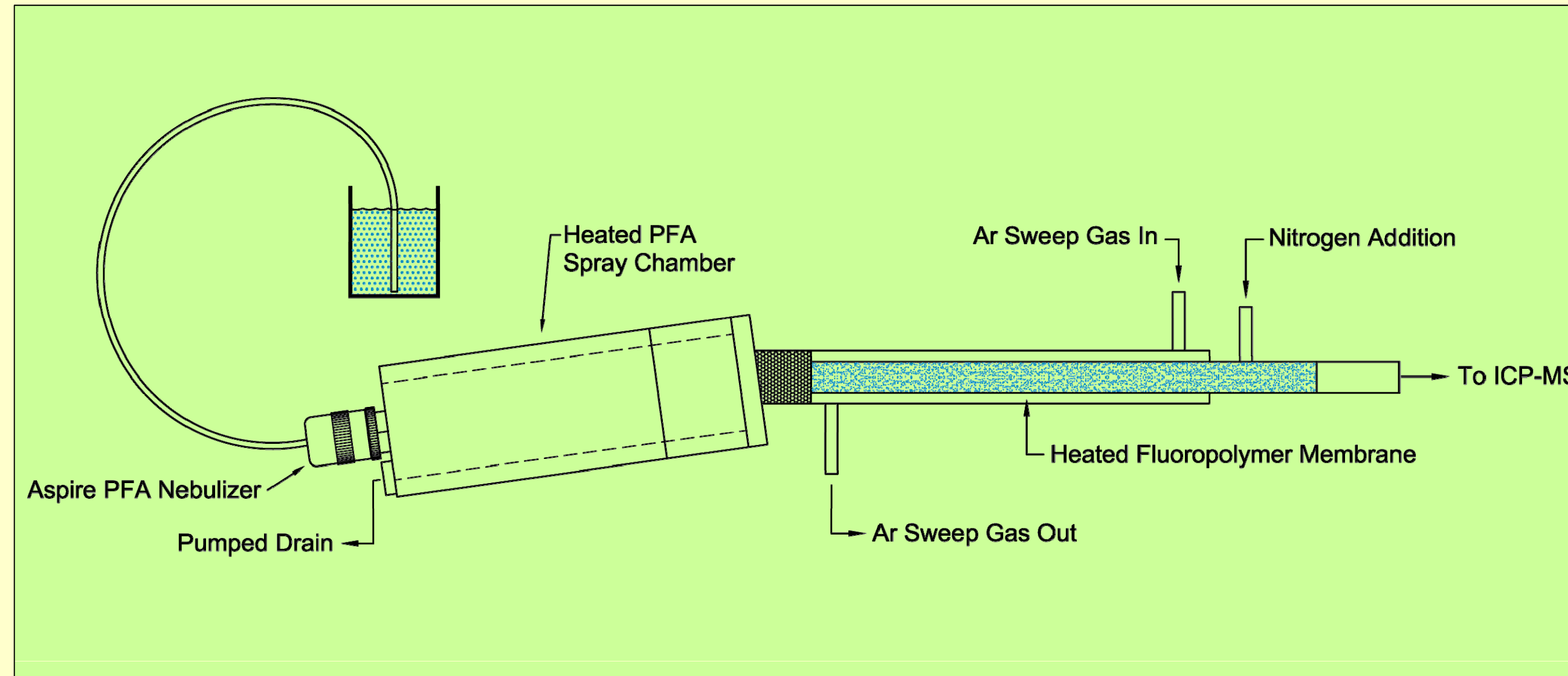
<sup>1</sup>CETAC Technologies, Omaha, Nebraska USA; <sup>2</sup>CETAC Technologies, Ely, Cambridgeshire UK; <sup>3</sup>Center for Star and Planet Formation, Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark

14306 Industrial Rd.  
Omaha, NE 68144  
USA  
PHONE 402.733.2829  
FAX 402.733.5292  
WWW CETAC.com

**Abstract:** Multicollector ICP-MS instruments are specialized devices for high-precision isotope ratio measurements. Prepared liquid samples may be concentrated (100 to 1000 µg/L) in elements of interest; these higher concentrations can cause longer analyte washout times and signal spikes. This poster describes a low flow (50 to 200 µL/min) desolvating nebulizer system with a fast washout capability. This nebulizer is also equipped with a dedicated autosampler that has a dual-flowing rinse capability to minimize any sample carryover. Wetted parts are composed of fluoropolymers such as PFA (perfluoroalkoxy) for lowest trace metal blanks and maximum chemical resistance. Optimum operating conditions for the nebulizer system with a contemporary multicollector ICP-MS are detailed, with data concerning signal enhancement and stability, interference reduction, and washout characteristics for U-series dating measurements.



CETAC Aridus II Desolvating Nebulizer System



Aridus II Schematic



QuickWash

## CETAC QuickWash Accessory

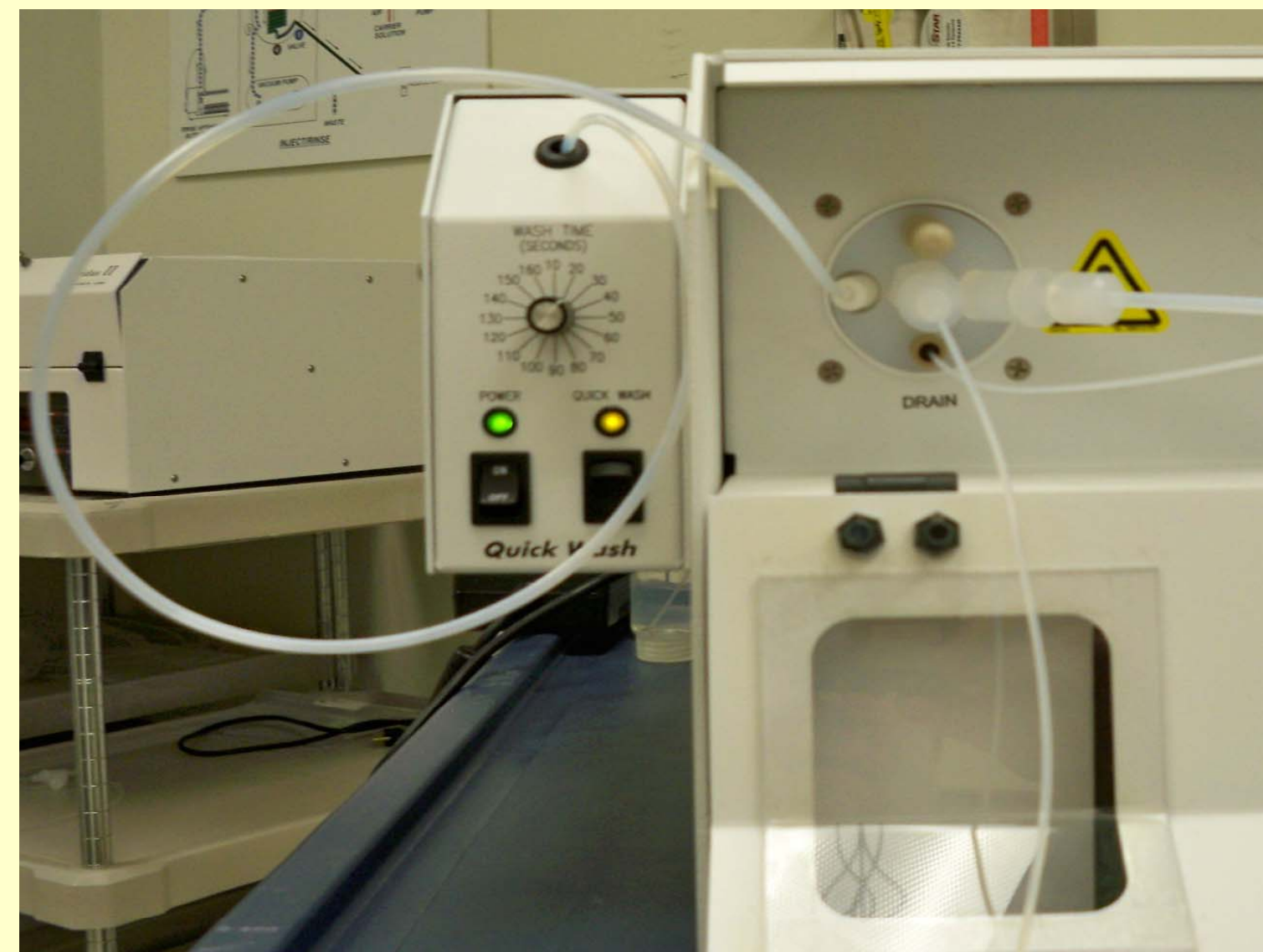
Useful for analyte concentrations above 100 µg/L, particularly U, Th, and W.

Consists of a gas/liquid line which provides a tangential spray of dilute acid inside the Aridus II spray chamber during the rinse cycle.

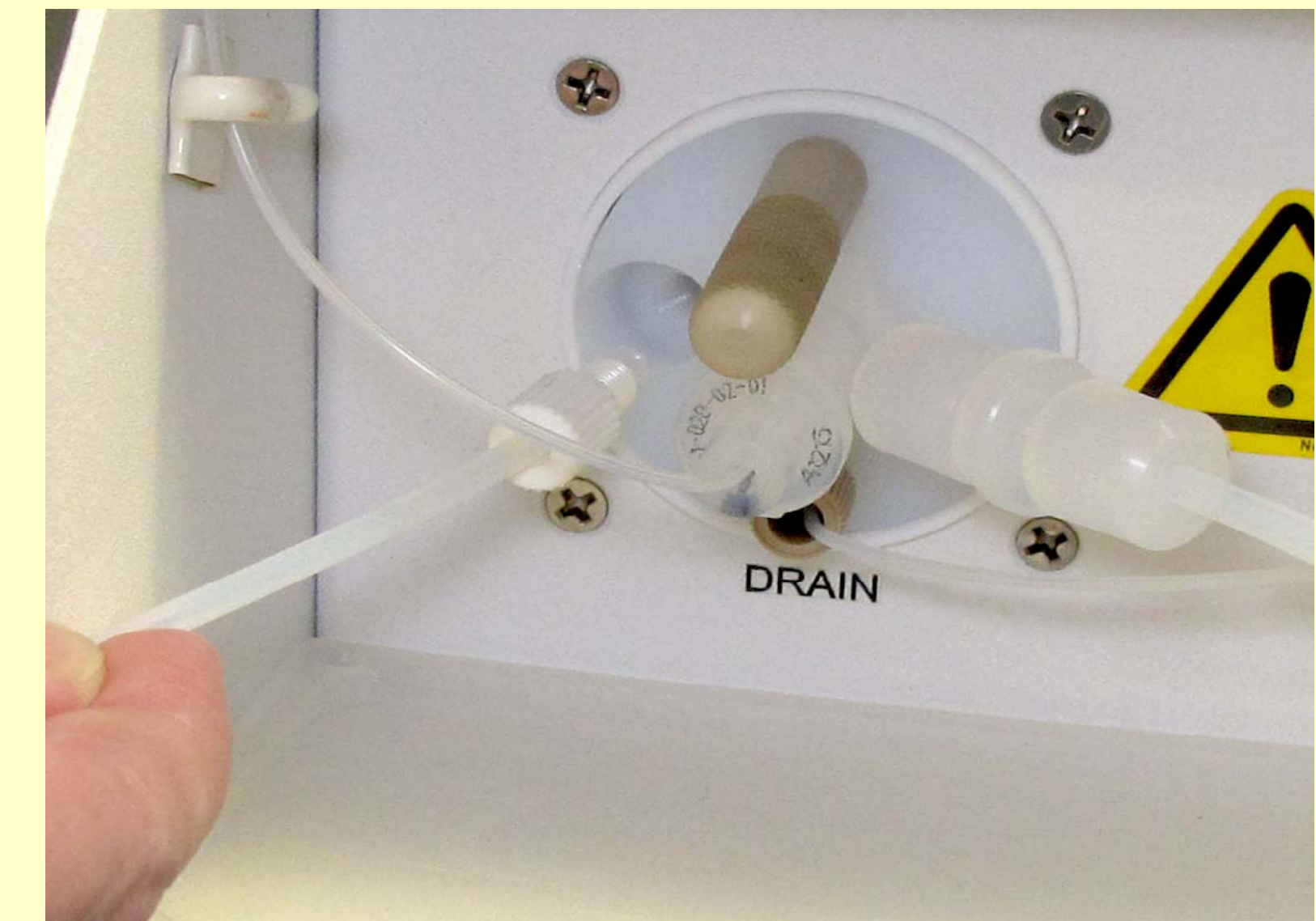
The QuickWash (QW) gas flow is 2 to 3 L/min Ar with a rinse solution flow of up to 2mL/min (pumped).

The QW can be triggered manually or via the ASX-112FR Autosampler.

The QW time is preset in increments of 10 sec up to 160 sec.



QuickWash Front View - Aridus II Door Open



QuickWash Gas-Liquid Line (at left)

## Nebulizer Operating Conditions

**Nebulizer System:** CETAC Aridus II  
**PFA Nebulizer:** PFA-50, PFA-100  
**Uptake rate:** 50 or 100 µL/min  
**Nebulizer Gas:** 0.60 L/min  
**Spray Chamber Temp:** 110 °C  
**Membrane Oven Temp:** 160 °C  
  
**Ar Sweep Gas:** 6.0 L/min  
**N<sub>2</sub> Addition Gas:** 8 mL/min

## MC-ICP-MS Operating Conditions

**MC-ICP-MS:** Thermo Neptune w. Jet Interface  
**ICP RF Power:** 1200 W  
**Plasma Gas:** 15 L/min  
**Auxiliary Gas:** 0.70 L/min  
**Nebulizer Gas:** 0.60 L/min  
**Torch Injector:** Quartz, 2.0 mm i.d.  
**Resolution:** Low  
**Integration time:** 8 sec  
**Cycles:** 96

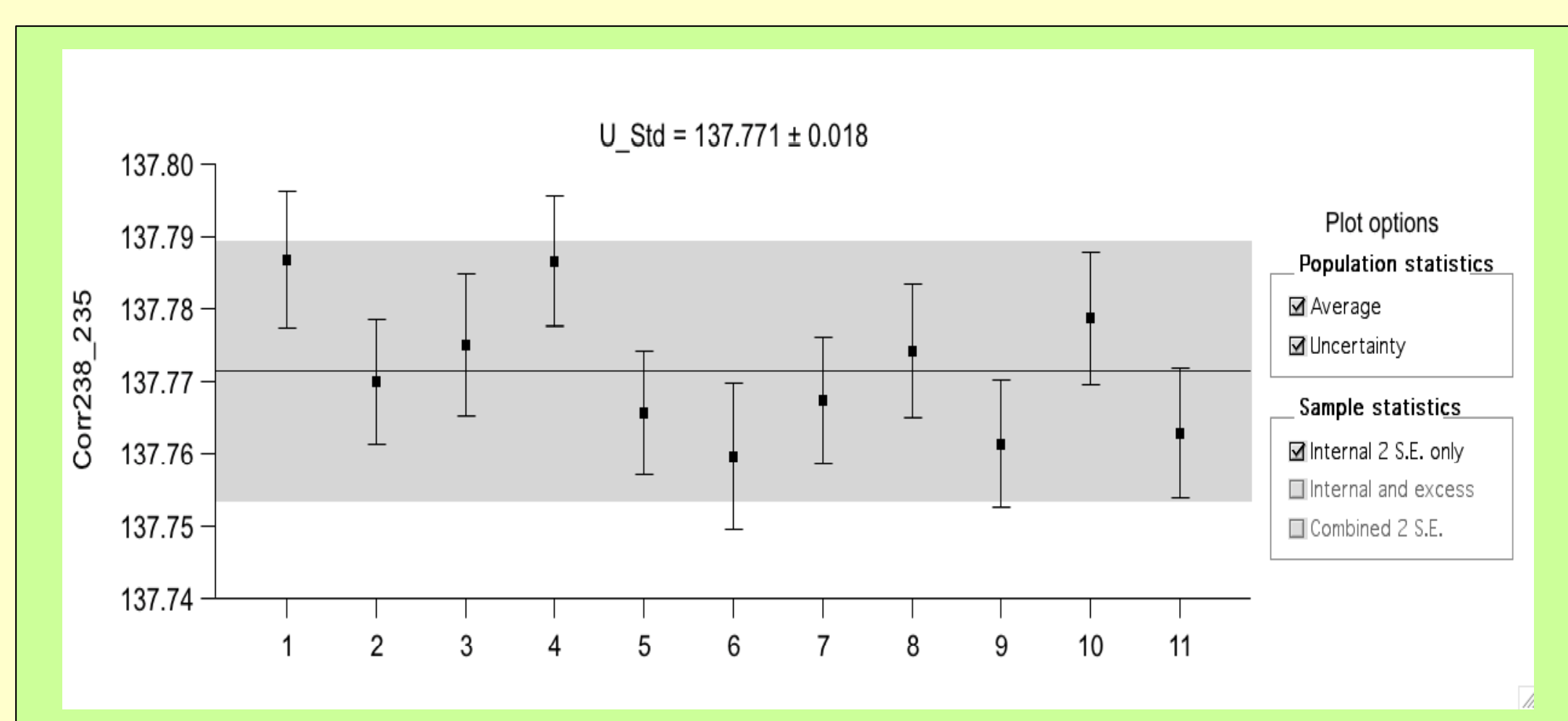
## Analytical Performance & QW Conditions

Typical <sup>238</sup>U signal of 2000V/ppm with Neptune and Aridus II. (Neptune in low resolution mode.)

External reproducibility of the ε<sup>238</sup>U values are 160 ppm (2σ) for 4 ng U and 80 ppm (2σ) for 16 ng U. The ε notation refers to the relative deviation of the <sup>238</sup>U/<sup>235</sup>U ratio from a reference standard (ex. CRM-145).

QuickWash rinse time is 70s using 2% high-purity HNO<sub>3</sub> for U and 2% HNO<sub>3</sub> with trace (0.02M) HF for W.

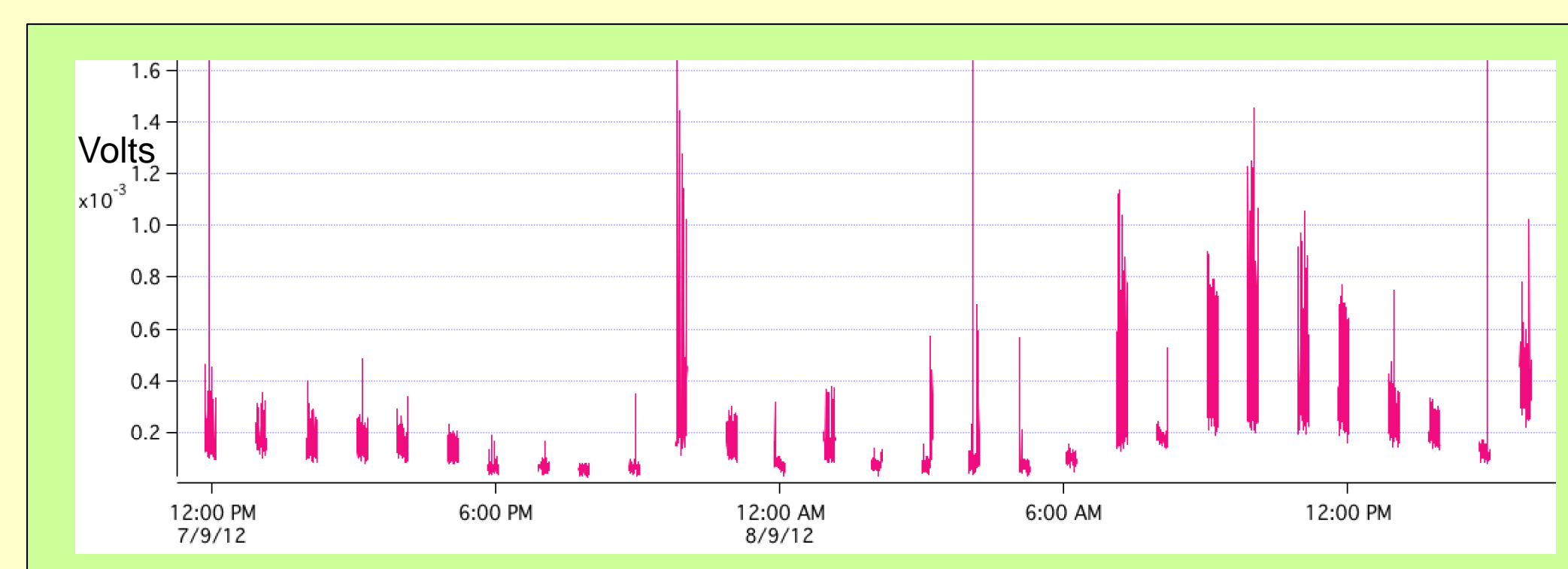
## Long-Term Measurement of <sup>238</sup>U/<sup>235</sup>U for CRM-112A



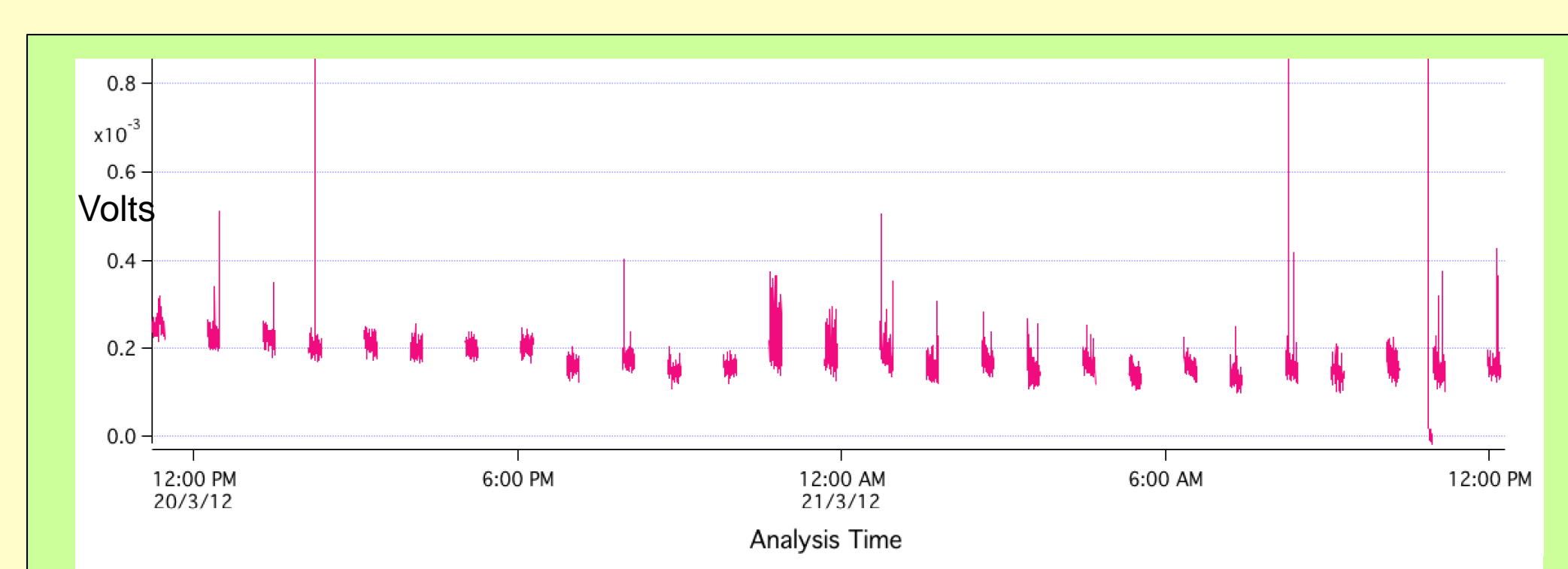
<sup>238</sup>U/<sup>235</sup>U ratio measured each hour (11 hours) for 14 minutes with a <sup>238</sup>U signal of 5V.

Correction for mass bias was performed using the double spike (<sup>233</sup>U/<sup>236</sup>U).

## <sup>184</sup>W Background Signal Without QuickWash



## <sup>184</sup>W Background Signal With QuickWash



10 µg/L W introduced to the Aridus II and MC-ICP-MS with a 50µL/min PFA nebulizer.

<sup>183</sup>W/<sup>184</sup>W measured for 15 minutes followed by a normal 30 minute washout. The <sup>184</sup>W background is then measured for 15 min (top graph).

<sup>183</sup>W/<sup>184</sup>W measured for 15 minutes followed first by a 70 sec QuickWash cycle and then a normal 30 minute washout. The <sup>184</sup>W background is then measured for 15 min (bottom graph). Background signal and W signal spikes are significantly reduced.

Overall, use of the QuickWash shortens washout times by 25%, as a typical measurement/washout cycle is now approximately 45 min. vs. 1 hour.

**References:**  
J.N. Connelly, M. Bizarro, A.N. Krot, A. Nordlund, D. Wielandt, M.A. Ivanova, *Science*, **338**, 651 (2012).