



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

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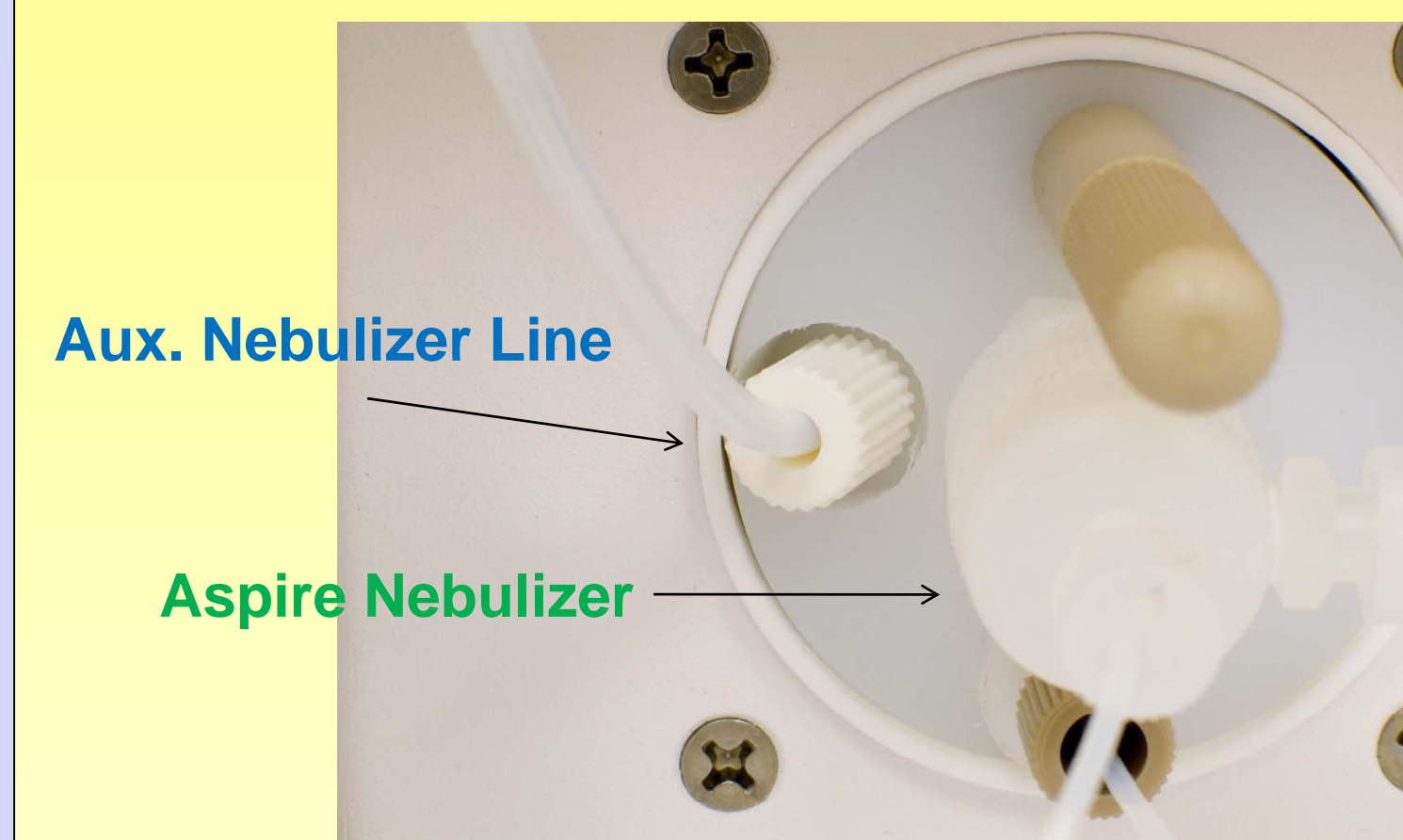
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## Abstract:

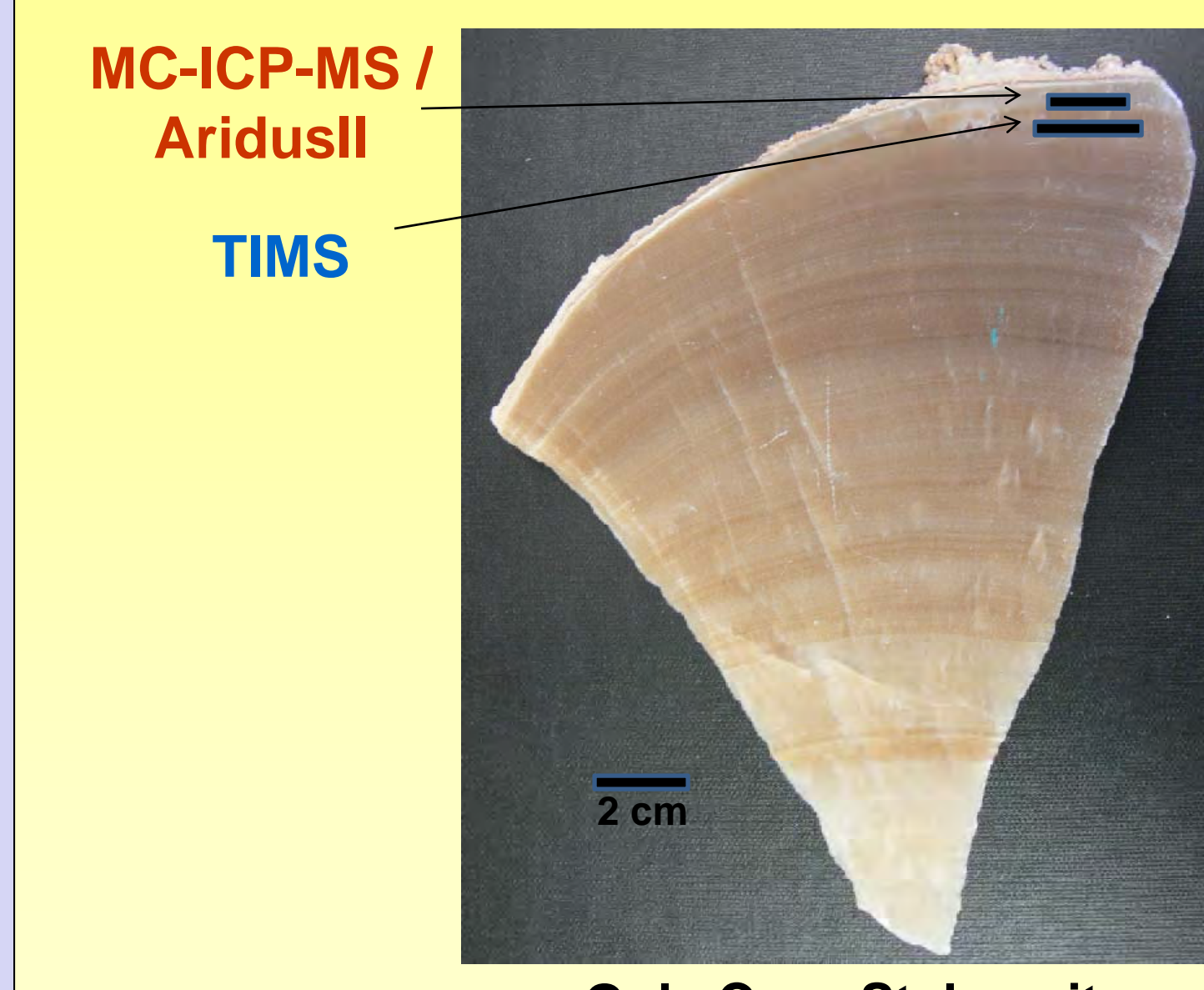
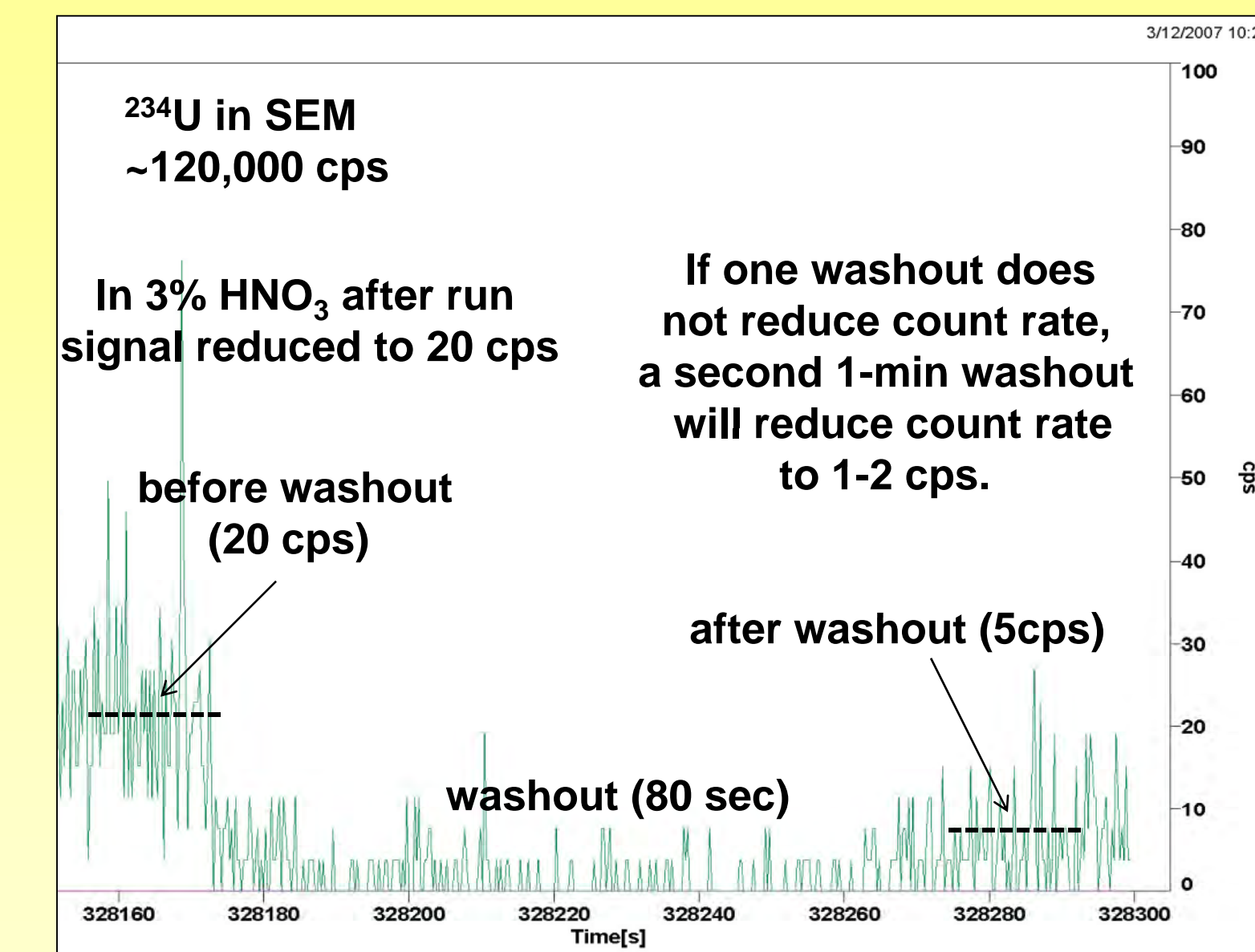
Multicollector ICP-MS instruments are specialized devices for high-precision isotope ratio measurements. Often prepared liquid samples are very concentrated, which can cause long analyte washout times and analyte signal spikes.

A low-flow, desolvating nebulizer system with a fast washout accessory will be described. This nebulizer system is also coupled 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 maximum, chemical resistance.

Optimum operating conditions for this combination system with a multicollector ICP-MS will be described, with data concerning signal enhancement and stability, interference reduction, and washout times. Application for the U-series dating of a stalagmite sample will be presented.



Close-Up View, AridusII Spray Chamber



Ogle Cave Stalagmite

## Instrumentation

### Multicollector ICP-MS:

Thermo Finnigan Neptune

### Desolvating Nebulizer:

CETAC AridusII & QuickWash Accessory

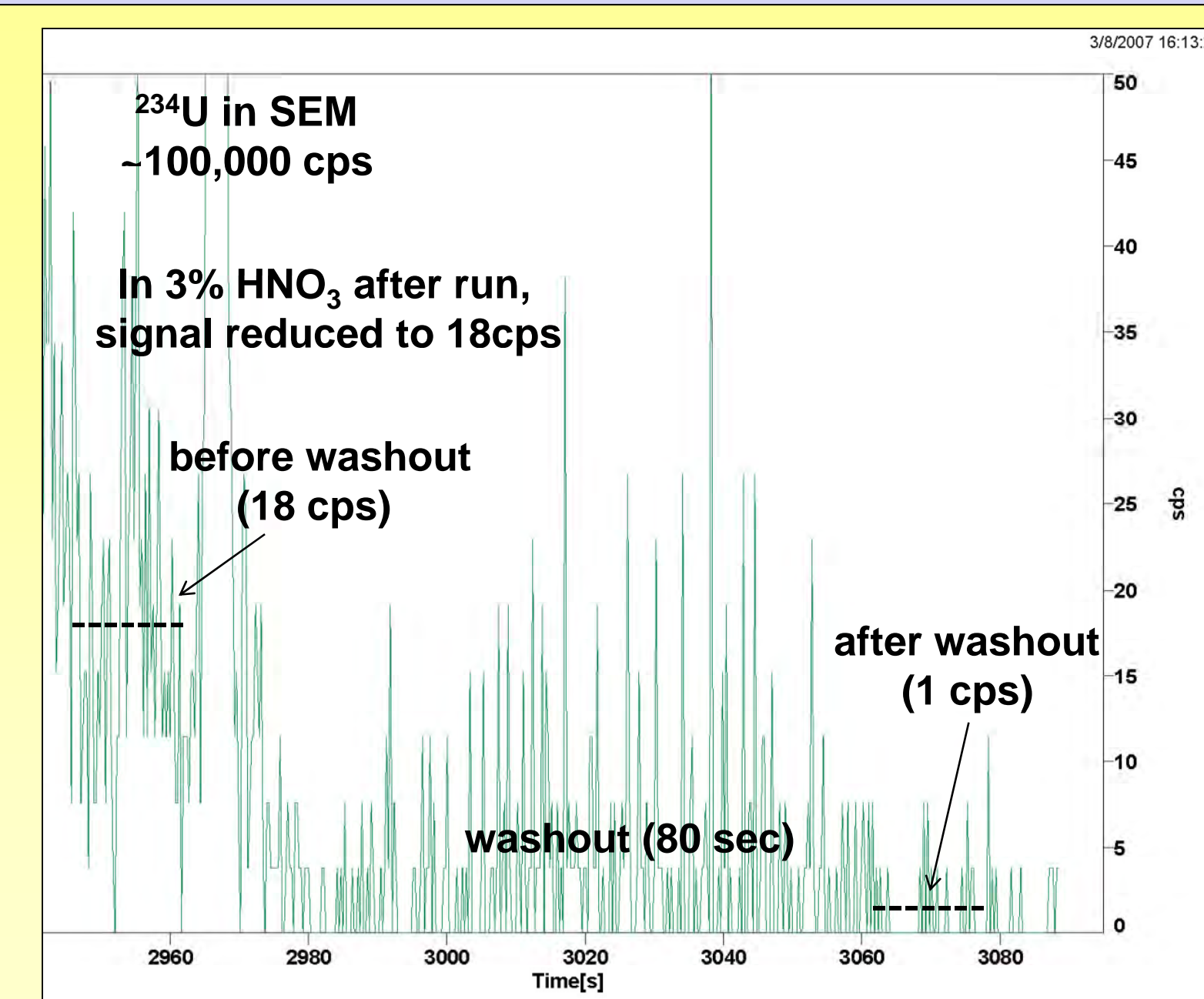
## Operating Conditions

### Thermo Finnigan Neptune MC-ICP-MS

ICP Power: 1200 W  
Aux. Gas Flow: 1 L/min  
Nebulizer Gas Flow: 0.8 L/min

### CETAC AridusII

Sample Uptake Rate: 100 µL/min  
Ar Sweep Gas: 10.5 L/min  
N<sub>2</sub> Addition Gas: 6 mL/min  
Spray Chamber Temp: 105°C  
Membrane Oven Temp: 160°C



## Results (Stalagmite):

The above stalagmite was dated in the late 1970s by U-Th alpha dating, with a reported value of 125,000 years.

More accurate U-series dating by thermal ionization mass spectrometry (TIMS) revealed the stalagmite top to have an age of 440 +130/-60 ka (1 ka = 1000 years)

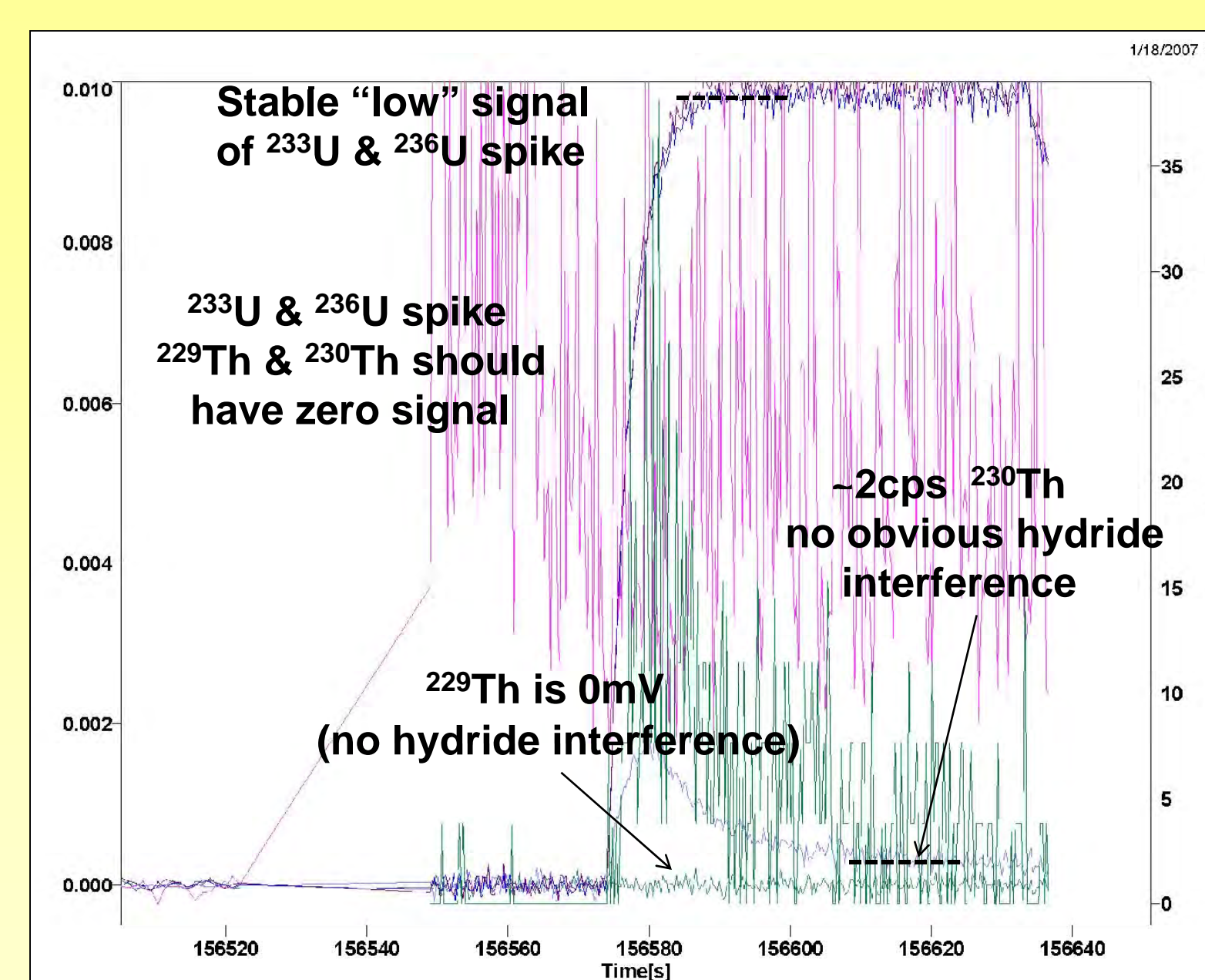
Use of MC-ICP-MS with the AridusII has significantly narrowed the absolute 2σ error: 440 +37/-29 ka.



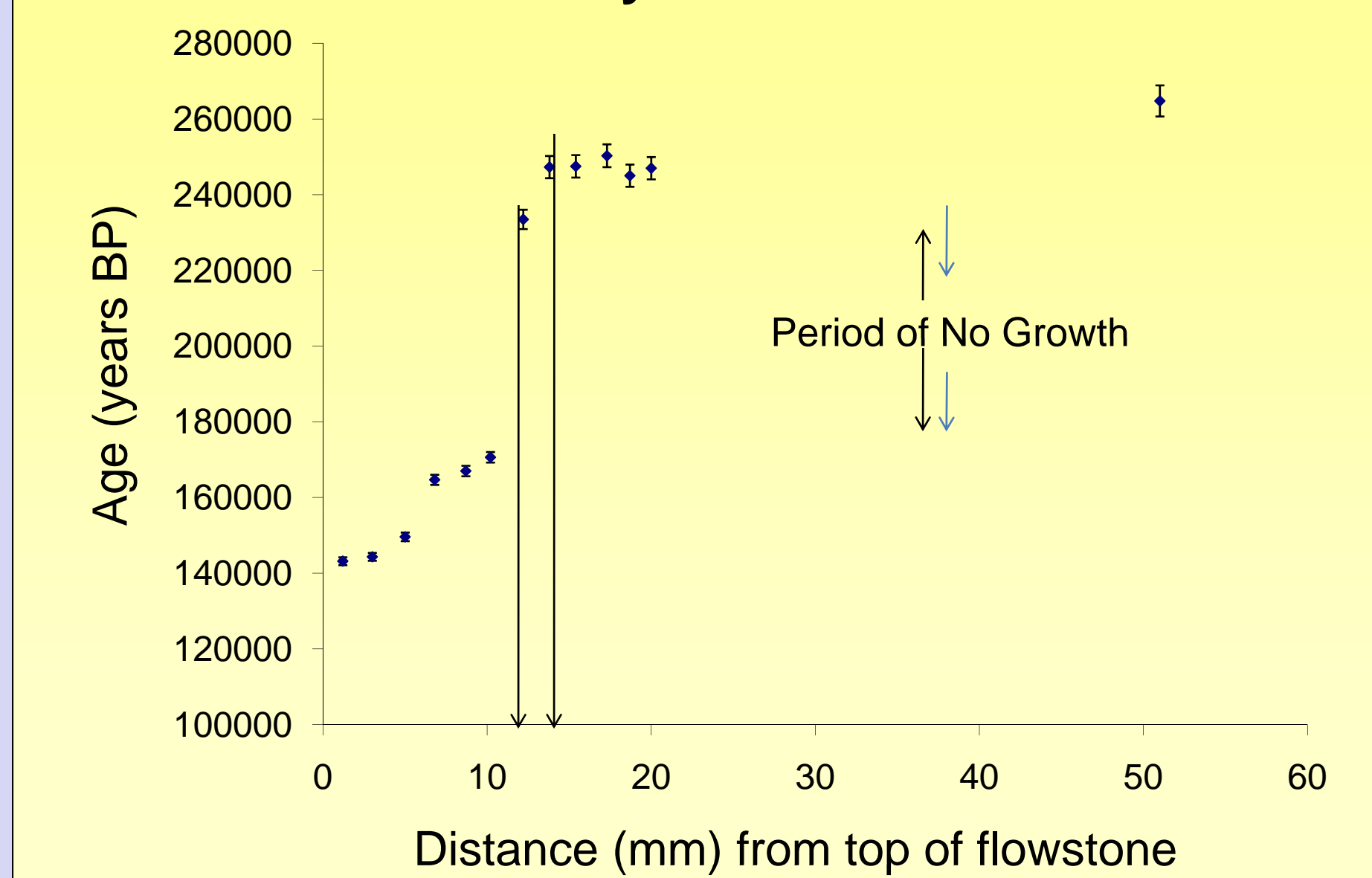
AridusII / ASX-112FR Autosampler & QuickWash

## CETAC AridusII Advantages

- Signal is 8-10 times greater using the AridusII (100µL/min) than the standard 50 µL/min nebulizer giving an overall effective signal increase of 4-5 times.
- No detectable hydrides (U-series analyses).
- Smaller samples are now routine (for U-series, use < 100 mg).
- Measurement times are significantly reduced by 5-10 times.
- Sample chemistry time reduced because of smaller samples.



## Study of Flowstone



QuickWash Accessory

## The Aridus II makes static runs on U-series samples routine & significantly reduces errors and measurement times

<sup>230</sup> Th/ <sup>229</sup> Th	1-σ % error	length of analyses	<sup>229</sup> Th count rate	amount of sample	instrument
0.024367	0.4481	2.5 hours	1800	~1/2	TIMS
0.024252	0.12398	0.2 hours	98,125	~1/8	MC-ICPMS*

\* - dilute solution, Thermo Neptune MC-ICPMS / Aridus II

U-series Age (yr)	δ <sup>234</sup> U ‰	length of analyses	amount of sample	Instrument
40,354 ± 417	1047 ± 4	4.0 hours	~1/2	TIMS
40,558 ± 257	1048 ± 3	0.5 hours	~1/8	MC-ICPMS/Aridus II

Typical <sup>233</sup>U or <sup>229</sup>Th spike count rates:

5000 cps using TIMS  
40,000 cps using MC-ICPMS without Aridus II  
300,000 cps using MC-ICPMS with Aridus II

## Application

### Dating Study of a Stalagmite

### Sample Location:

Ogle Cave in Carlsbad Caverns National Park, New Mexico USA

### Sample Size:

TIMS: 0.236g  
MC-ICP-MS/AridusII: 0.078g

## Results (Flowstone):

Aridus II was used with a Thermo Neptune MC-ICPMS to acquire the results shown in the figure above. The U-series ages are used to look for growth hiatuses that do not show up visually in the flowstone sample. Multiple analyses show a hiatus of flowstone growth between 11 and 13 mm from the top of the flowstone. These data indicate the growth of the flowstone took place in two phases, one occurring from 170 to 140 kyr BP, and another occurring between 265 and 245 kyr BP. Each growth period corresponds to a glacial episode in the Southwestern USA.

### Acknowledgement:

CETAC would like to thank Dr. Yemane Asmerom and Dr. Victor Polyak of the Univ. of New Mexico for data collected with the Neptune MC-ICP-MS and the AridusII.