## Workshop on High Resolution Proxies of Paleoclimate

Madison, Wisconsin June 18-21, 2017

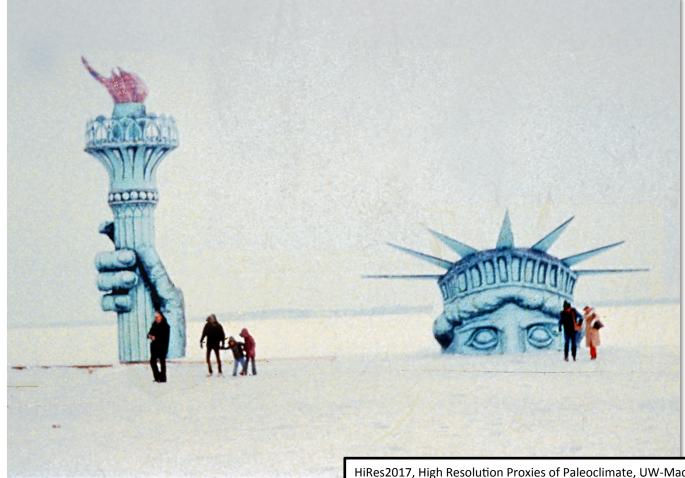




HiRes2017





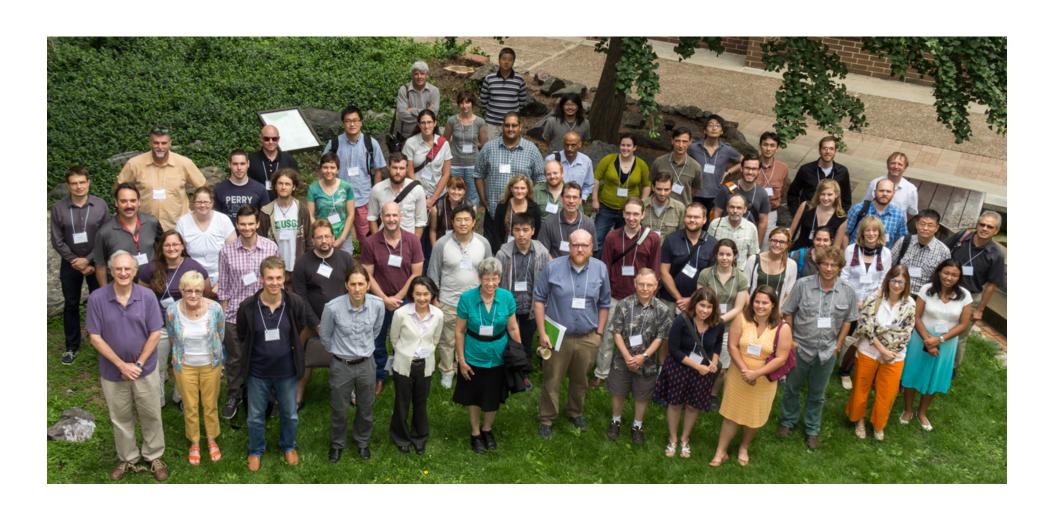


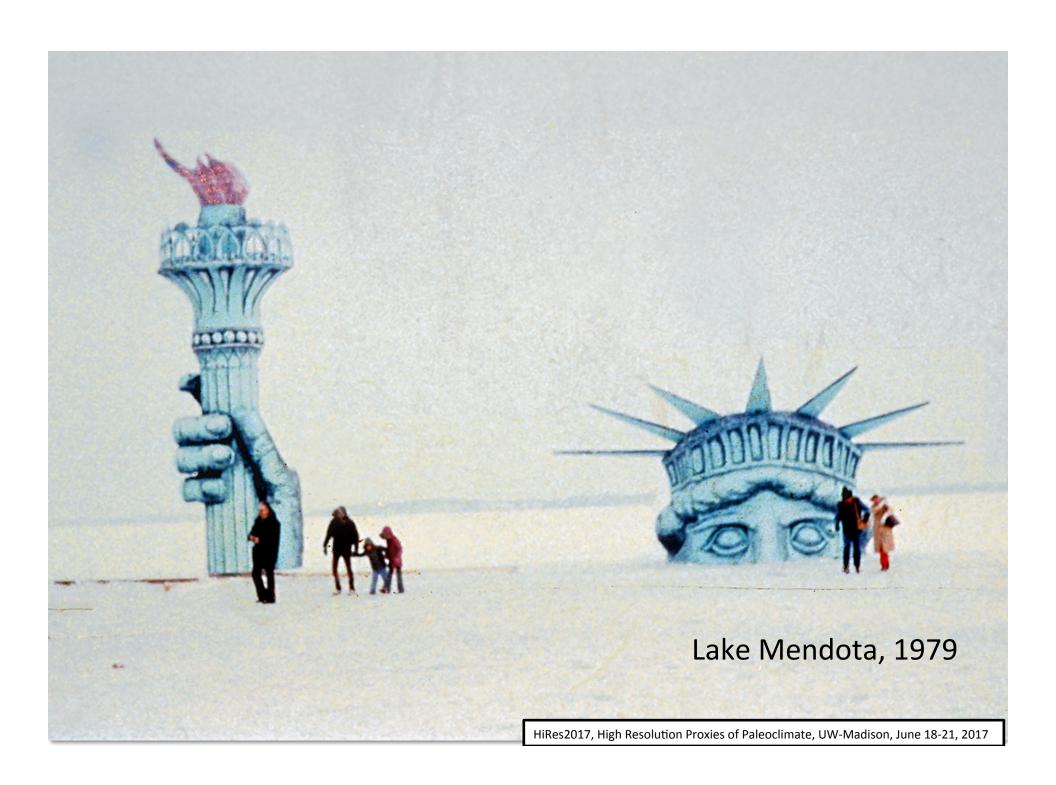
HiRes2017, High Resolution Proxies of Paleoclimate, UW-Madison, June 18-21, 2017

## HiRes2015



# HiRes2013





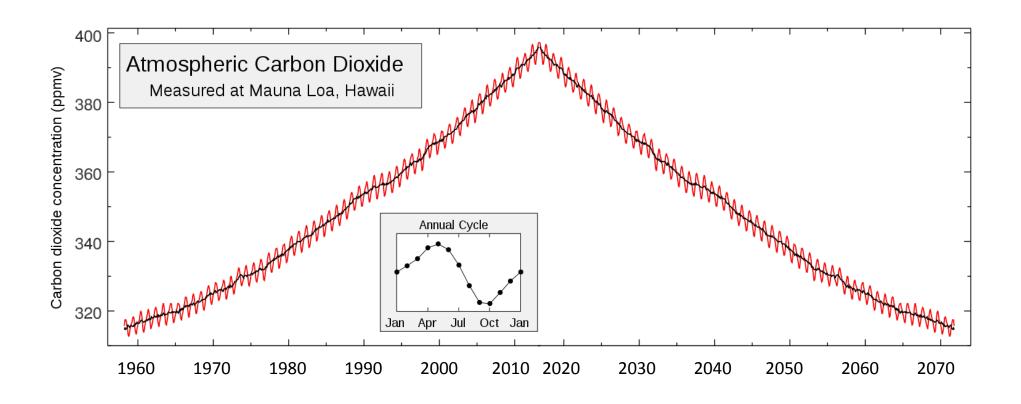


## Pail & Shovel Party

University of Wisconsin-Madison First day of classes Sept. 1979



Proposed to change all students' names to Joe Smith so that professors would know everyone by name. Promised to order all campus clocks to run backwards so classes would be over before they could begin.



If the Pail and Shovel Party ran climate change.

Prediction is very difficult, especially if it's about the future.

Niels Bohr, Piet Hein, Yogi Berra .....



1979



increased in importance. But it is only during the last half of the nineteenth century that the quantity of carbon compounds artificially oxidized has become of importance. In the year 1899 the amount of coal mined and oxidized amounted to 723,287,454 metric tons. At the beginning of the last decade of the nineteenth century, 1890, the production was only 511,518,358 metric tons.<sup>a</sup> This shows how rapid the increase in the use of coal has been, and therefore a combustion of 1,000,000,000 metric tons a year is probably very conservative as the estimated average for the present century. Taking 1,000,000,000 metric tons as the amount of coal oxidized per annum for the future, and supposing the amount of carbon in this coal to average 80 per cent, the quantity of CO<sub>2</sub> which passes into the atmosphere would be 2,933,333,000 metric tons per annum. This is 0.1233 per cent of the total amount of CO<sub>2</sub> at present in the atmosphere. (See p. 972.) If this rate of consumption of coal were continued eight hundred and twelve years the amount of CO2 in the atmosphere would be doubled.

It therefore appears probable that within a comparatively short time in the future, as compared with a single geological period, or even an epoch, the amount of CO<sub>2</sub> in one of its great reservoirs, the atmosphere, will be increased to an important extent. From this fact various geological consequences are likely to follow. One of the most important of these is a higher average of temperature for the globe. According to Arrhenius, "if the carbon dioxide is increased 2.5 to 3 times its present value, the temperature in the arctic regions must rise 8° to 9° C. and produce a climate as mild as that of the Eocene period." According to the above computation, the CO<sub>2</sub> would be increased by the oxidation of coal alone to three times its present amount in one thousand six hundred and twenty-four years. Certain it is, if Arrhenius be correct, and the coal supplies of the world are sufficient to meet the demands of man for thousands of years, that a most profound change will take place in the climate of the world.

TREATISE ON METAMORPHISM 1904

USGS Monograph 47, 1286 p.

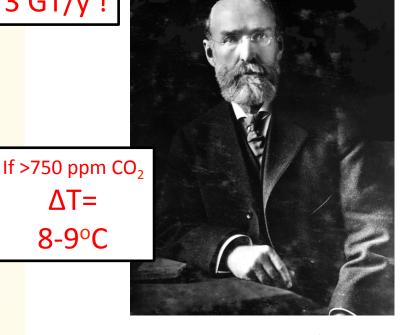
CHARLES RICHARD VAN HISE



 $CO_2$ 

Coal

only



C. R. Van Hise President UW-Madison 1903-1917

Chamberlin **Arrhenius** 

 $\Delta T =$ 

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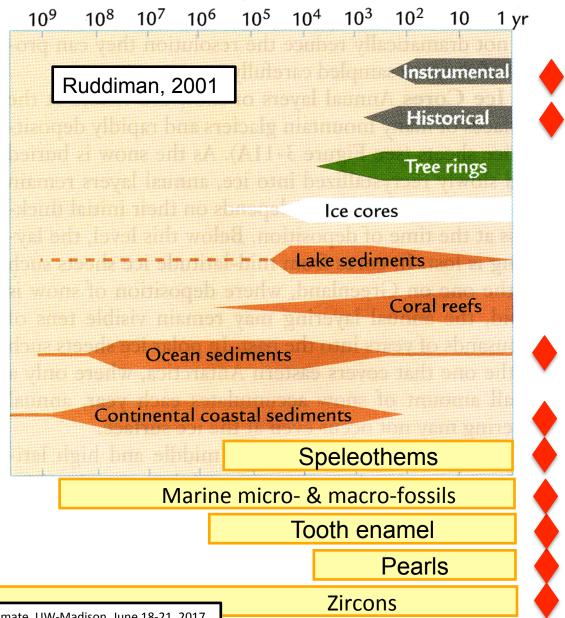
<sup>&</sup>quot;Parker, E. W., Mineral Resources of the United States, 1899; Coal: Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 6, 1901, p. 369.

b Chamberlin, T. C., An attempt to frame a working hypothesis of the cause of the Glacial periods on an atmospheric basis: Jour. Geol., vol. 7, 1899, pp. 545-584.

Arrhenius, Syante, On the influence of carbonic acid in the air upon the temperature of the ground: Philos. Mag., 5th ser., vol. 41, 1896, pp. 237-276. Summary in Jour. Geol., 623-625.

## Records of climate change

Time span of record







#### What are the new opportunities for high-resolution study of paleoclimate proxies? Formation of Earth Humans Jack Hills Cells Zircons with Nucleus Late **Bombardment** Age: Billion Years 4.6 Gá 0 Ga 2.5. 0.5 **Proterozoic** Phanerozoic Archean **H**adean` Isua: Sediment Isotopic Evidence for Life Rise in **Apex Chert** Core Formation Hard-shelled Atmospheric Fossils Animals Oxygen Dinosaurs Acasta Gneiss Moon Formation © Andrée Valley 2014 Mars Sediment

## >4.4 byr of Paleoclimate

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## High-Resolution Proxies of Paleoclimate

```
Imaging
   Sample polish, colloidal alumina or silica
   Optics: visible, reflected, UV
   SEM: CL, BSE, SE, EBSD
   Laser fluorescent confocal microscopy
Electron microprobe
SIMS: isotopes, trace elements, light elements
Laser-ablation ICP-MS: TOF, quadrupole,
   magnetic sector; ns and fs laser
Scanning XRF
TFM
Synchrotron
Atom probe
  CAMECA Users Meeting, Madison, June 12-15, 2017
Raman, IR
```

## Ion microprobe = SIMS Isotopes, Trace elements, Light elements

Complements: Electron microprobe (Major and minor elements)

1-10 µm spots, in situ

## "Traditional Uses"

## Petrology

Igneous & Metamorphic minerals Zircons, Diamonds & inclusions Ore deposits Diagenetic cements

## Astrobiology

Microfossils, C-isotopes, TE's Sulfur 4-isotopes

Meteorites/ Moon

#### **Materials Science**

Thin films, depth profiles Trace elements

## Biology

Biominerals
Single bacteria
Tissue
Intracellular material

## Anthropology & Archeology

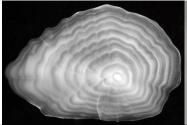
## Paleoclimate Proxies

Foraminifera, Coral, Sponges, Mollusks,
Diatoms
Speleothems
Fish otoliths
Tooth enamel
Finely layered sediments
Pollen, .........





Small, Precious or Zoned





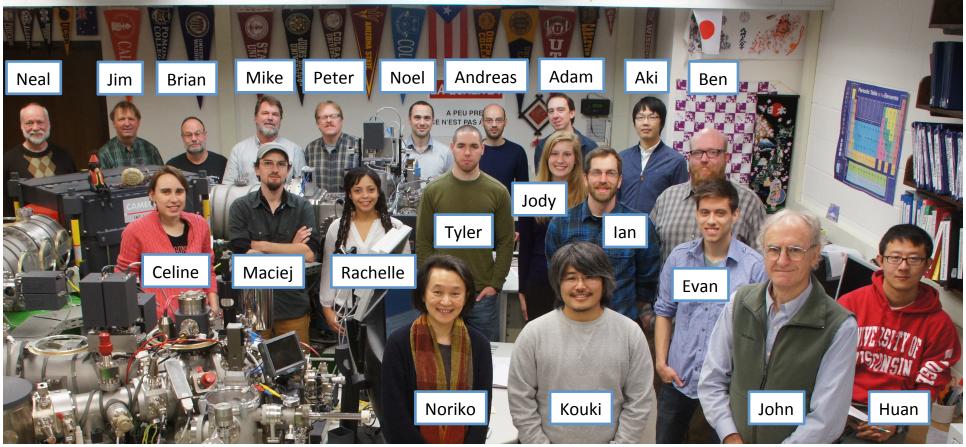
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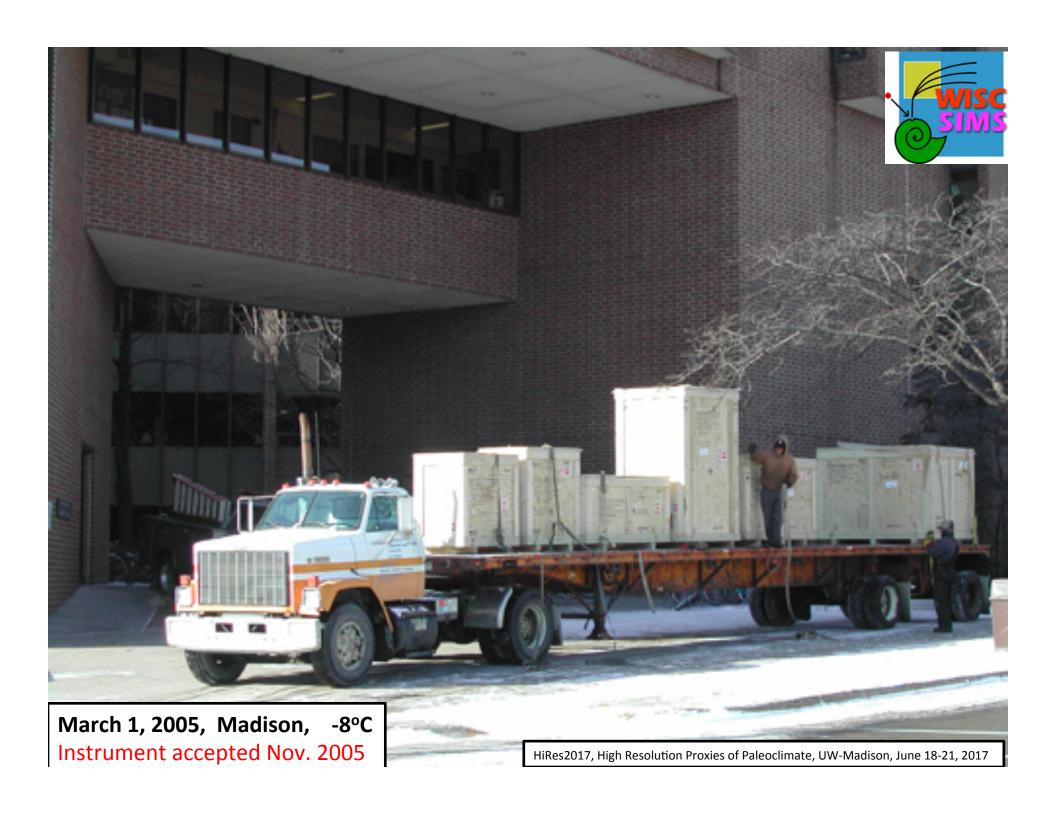


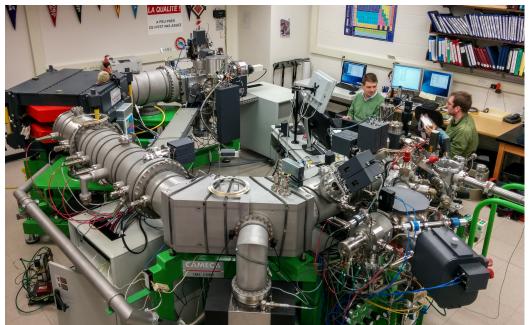
## **WiscSIMS**

Dept. of Geoscience University of Wisconsin-Madison NSF-supported National Facility



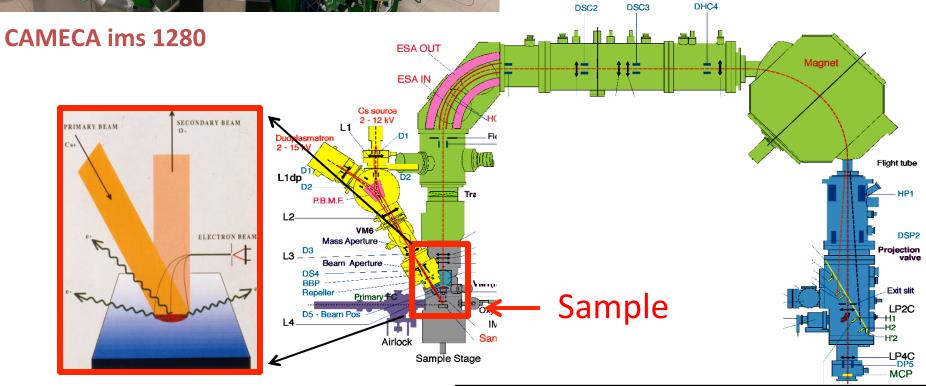


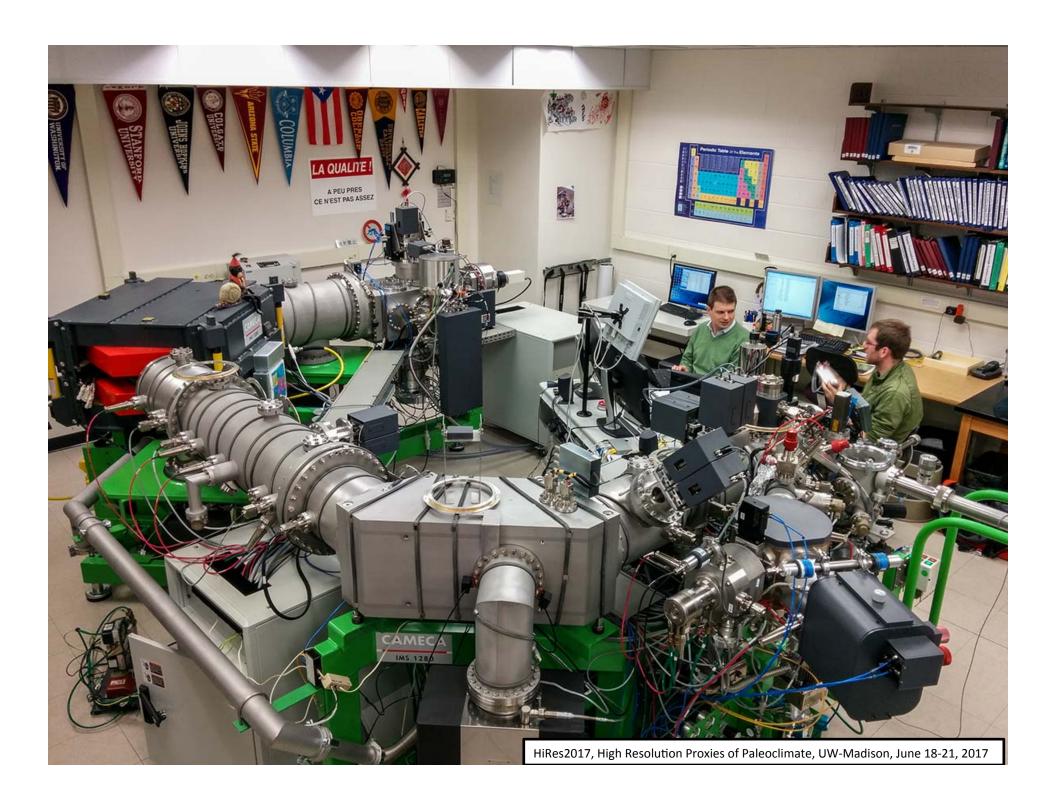




# Secondary Ion Mass Spectrometer SIMS Ion Microprobe







#### Mon. June 19 Room A140, Weeks Hall (Chair: Ian Orland)

9:00-9:20	John Valley Welcome and Introduction
9:20-10:20	Noriko Kita (Tutorial): "SIMS Basics"
10:20-10:40	Ian Orland & Kouki Kitajima WiscSIMS-Live Part 1
10:40-11:00	Break
11:00-12:00	John Valley (Tutorial): "In Situ Isotope Geochemistry by SIMS: Accuracy vs. Precision"

#### Lunch (12:00PM-1:30PM) at Union South (check monitors)

#### **Afternoon Session (Chair: John Valley)**

1:30-1:50	Shaun Marcott (Keynote) "Heinrich Events, oxygen isotopes, and foraminifera:
	What can SIMS do for you?"
1:50-2:20	Zhengyu Liu (Keynote) "Understanding the temporal slope of the temperature-water
	isotope relation: The slope equation"
2:20-2:50	Kathleen Johnson (Keynote) "Reconstructing seasonal to decadal scale climate variability
	from speleothems: Potential, strategies, and challenges"
2:50-3:10	lan Orland "Measuring seasonal monsoon signals in Chinese speleothems"
3:10-4:00	Lightning Poster Talks Optional, 3 minutes/poster.

#### Posters (4:00PM-6:00PM)

**Dinner** (on your own, see restaurant list & map)

After dinner see Isthmus, Union Terrace, Read abstracts

## **Union Terrace**

Mon June 19 9 PM Rogue One: Star Wars

Wed June 21 8-11 PM Open Mic Night-

music, poetry, comedy

Thurs June 22 5-7 PM Boo Bradley- blues

9 – Midnight- Soul Low





#### Tue. AM June 20 Room A140, Weeks Hall (Chair: Howard Spero)

8:30-9:00 AM	Light Breakfast
9:00-9:30	<b>Thure Cerling (Keynote)</b> "Stable Isotope Answers to Problems with Biological and Terrestrial Records"
9:30-10:00	Melanie Beasley (Keynote) "Environmental variability in hominin evolution: Moving from geological to biological timescales with SIMS"
10:00-10:20	Noreen Tuross "The Need for HiRes in Vertebrate Calcified Tissue Oxygen Isotope Measurements"
10:20-10:40	<b>Daniel Green</b> "Mineralization modeling and Bayesian inference reconstruct transient storms from tooth d <sup>18</sup> O values"
10:40-11:00	Break
11:00-11:30	Wolfgang Müller (Keynote) "The Role of Laser-Ablation Plasma Mass Spectrometry (LA-ICPMS) in Palaeoclimate Research: Principles and Applications"
11:30-11:50	Robert Sherrell "High-resolution analysis of deep-sea coral skeletons for trace element paleo-proxies of ocean conditions"
11:50-12:10	Xin-Yuan Zheng "In situ Fe isotope analysis by femtosecond laser ablation: fundamentals and applications"

#### Group photo & Lunch (12:10PM-2:00PM)

Group Photo will be taken in Weeks Hall courtyard immediately following the morning session. Lunch at Union South (check monitor).

### Tue. PM June 20 Room A140, Weeks Hall Afternoon Session (Chair: Reinhard Kozdon)

- 2:00-2:30 Jennifer Fehrenbacher (Keynote) "Light cycle triggers Mg-banding in Neogloboquadrina dutertrei: implications for chamber formation and biomineralization in planktic foraminifers"
- 2:30-3:00 **Howard Spero (Invited)** " Carbon and nitrogen exchange between a photosynthetic symbiotic dinoflagellate and its planktonic foraminifera host"
- 3:00-3:20 **Helena Filipsson** "Opening the proxy black box: unravelling biomineralization processes using synchrotron X-ray spectroscopy and plasma analytical methods"
- 3:20-3:40 Break
- 3:40-4:00 **Alan Wanamaker** "Assessing unexpected isotopic variability in aragonitic biocarbonates through sample replication"
- 4:00-4:30 **Thomas Helser (Keynote)** "Trace elements, isotopes and growth increments: Paleoclimate and fish otoliths"
- 4:30-4:50 **Evan Cameron** "Hadean paleoclimate: OH/O ratios as a proxy for water & alteration in zircon"

#### **Banquet (Alumni Lounge at the Pyle Center)**

6:00 PM Cocktail Hour

7:00-9:00 PM Dinner

## Wed. June 21 Room A140, Weeks Hall

8:30-9:00 AM Light Breakfast

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9:00-9:40	<b>Ian Orland (Tutorial)</b> "Developments and challenges in ion microprobe studies of speleothems and biocarbonates"
9:40-10:10	<b>Reinhard Kozdon (Keynote)</b> "In situ analysis of foraminiferal shells by SIMS, LA-ICPMS and EPMA: What have we learned in the past decade? A résumé and outlook"
10:10-10:30	Caitlin Livsey "Reconstructing Holocene Arctic Ocean paleoceanography using SIMS $\delta^{18}$ O and LA-ICP-MS elemental data from single Neogloboquadrina pachyderma shells"
10:30-10:50	Break
10:50-11:10	<b>Jody Wycech</b> "Reconstructing the Oxygen Isotope Composition of the Surface Ocean using Paired <i>In Situ</i> Micro-Analytical Techniques on Individual Shells of the Planktic Foraminifer <i>Trilobatus sacculifer</i> "
11:10-11:30	Ben Linzmeier & Kouki Kitajima WiscSIMS-Live Part 2
11:30-12:00	Ben Linzmeier (Tutorial) "Integrating in situ geochemical data with QGIS"

## Lunch (12:00PM-1:30PM)

Lunch at Union South (check monitors)

2:00 **Ben Linzmeier** QGIS Mini-workshop

Locations of stuff
Maps
WC, turn right
Lunch, Union South (check monitors)
Gluten free, Ask for your sandwich
Banquet, Pyle Center

Upload talks, posters

Locations of stuff
Maps
WC, turn right
Lunch, Union South (check monitors)
Banquet, Pyle Center

WiFi: PW from Union South

UW Net: Use "guest"

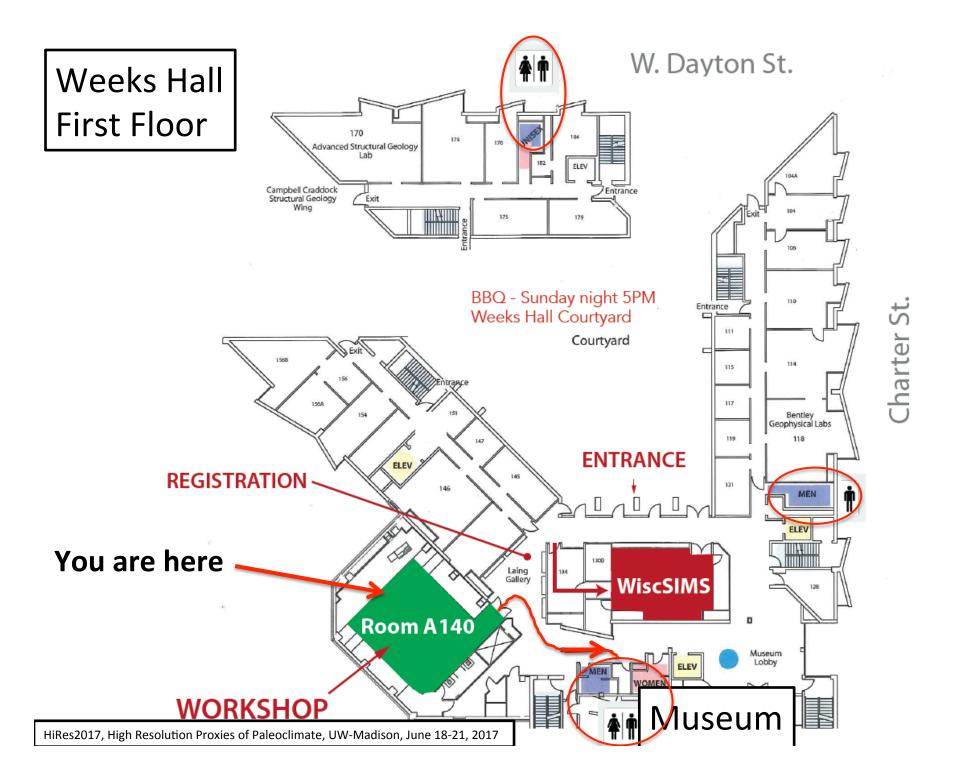
p. 3 in book, Ask Kouki or Ian

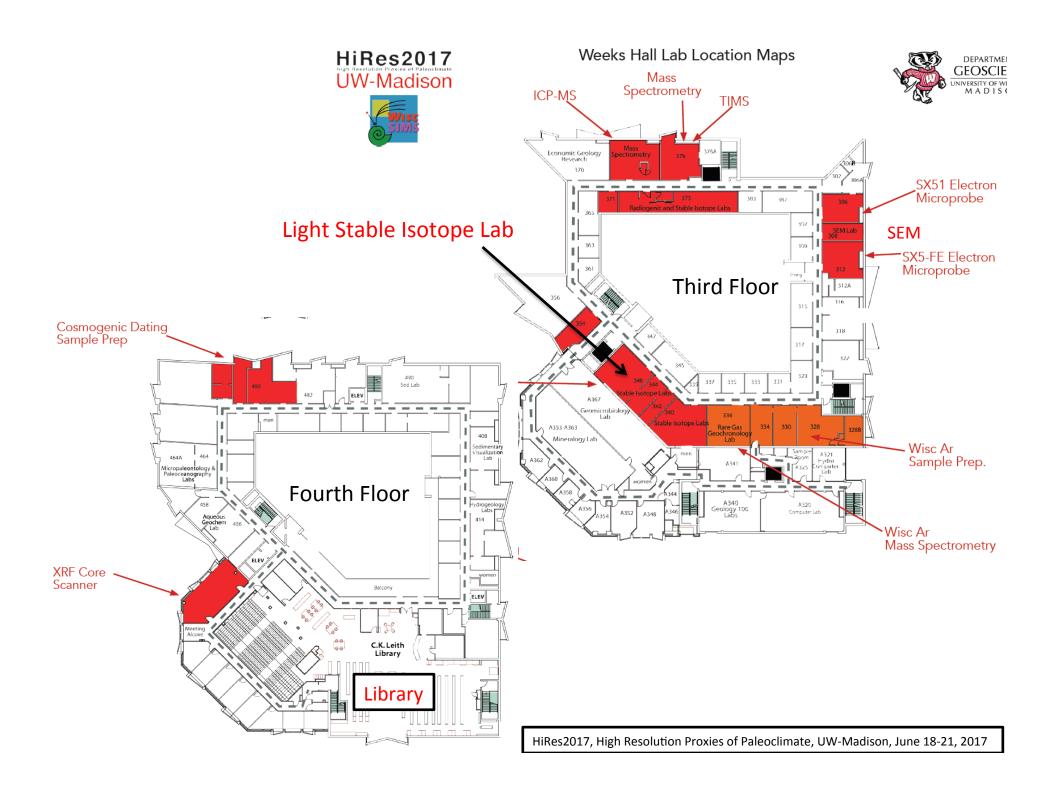
1 access point in A140, Access in lobby

Upload talks, posters

WHO GOT BUCKY?

W. Dayton St. Weeks Hall First Floor Advanced Structural Geology Lab Campbell Craddock Structural Geology Wing Entrance BBQ - Sunday night 5PM **Charter St.** Weeks Hall Courtyard Courtyard Bentley Geophysical Labs **ENTRANCE REGISTRATION** You are here WiscSIMS Room A140 Museum Lobby **WORKSHOP** Museum HiRes2017, High Resolution Proxies of Paleoclimate, UW-Madison, June 18-21, 2017





## Union South Lunch & Hotel



Pyle Center Tue. Banquet

