

Resolving Micron Scale $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ Heterogeneity in Cultured Planktic foraminifera

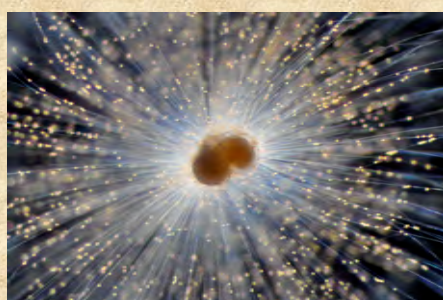
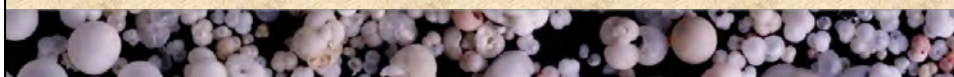
Howard Spero, Lael 'Spider' Vetter, Claudia Mora,
Reinhard Kozdon and John Valley

High Resolution Proxies of Paleoclimate Workshop, June 24, 2013



Los Alamos National
Laboratory

One of the most important climate archives - the CaCO_3
shells of planktonic foraminifera



Pre-sphere, trochospiral
shell form of *O. universa*



Spherical chamber form of
O. universa

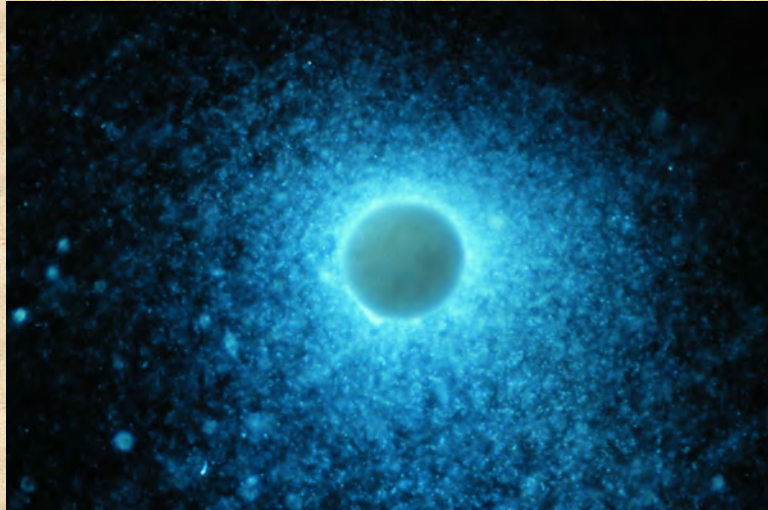
Most foraminifera grow their shells over 2-4 weeks. The *O. universa* sphere typically thickens for 3-7 days before completing its life cycle.



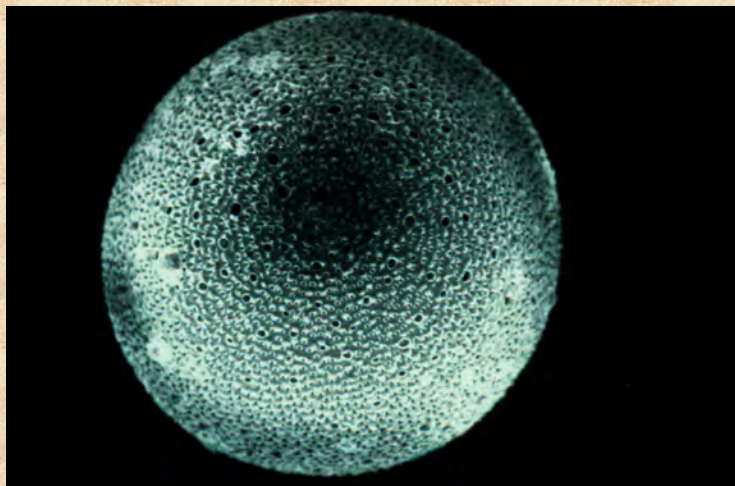
After 3-7 days, the spines are shed via selective resorption; the nucleus undergoes meiotic division



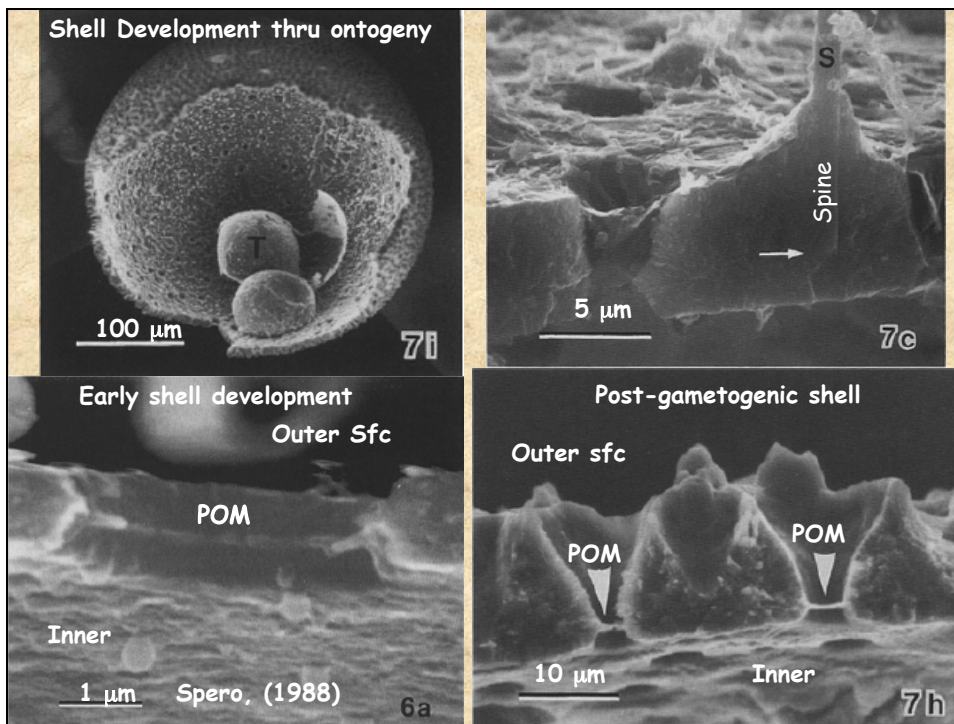
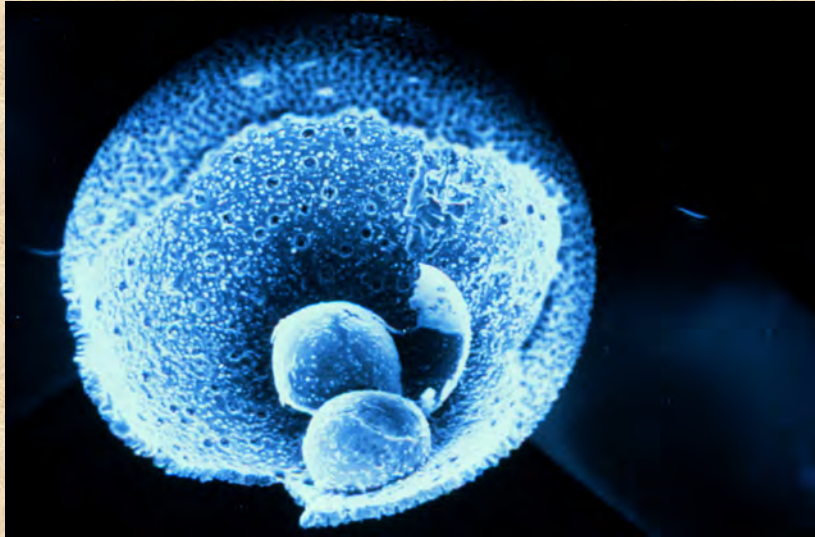
Gamete release generally occurs within 24 hours of spine resorption

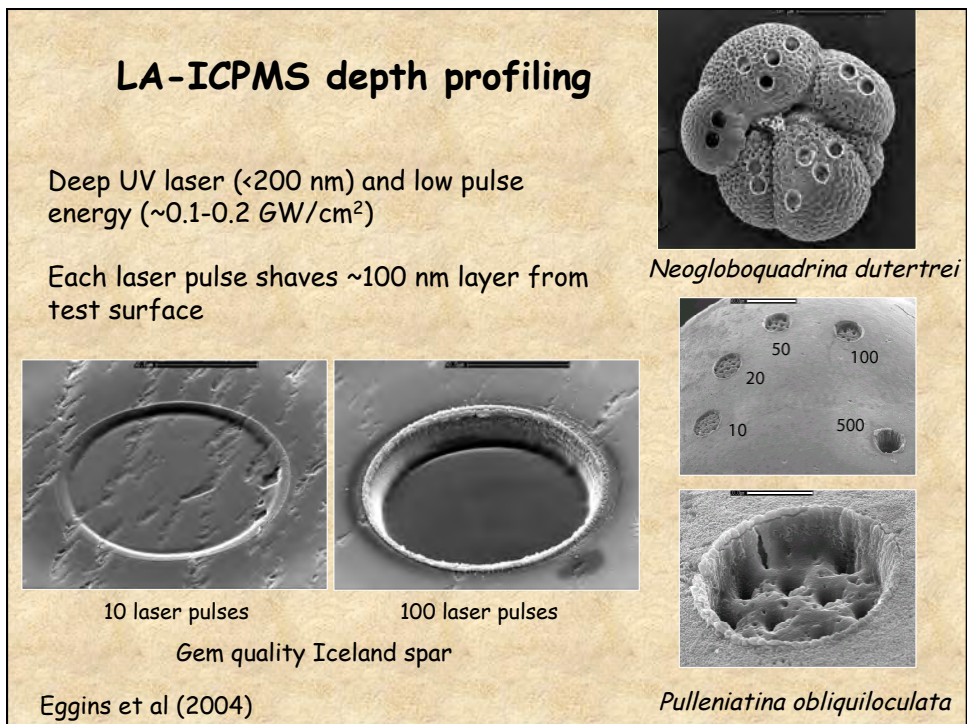
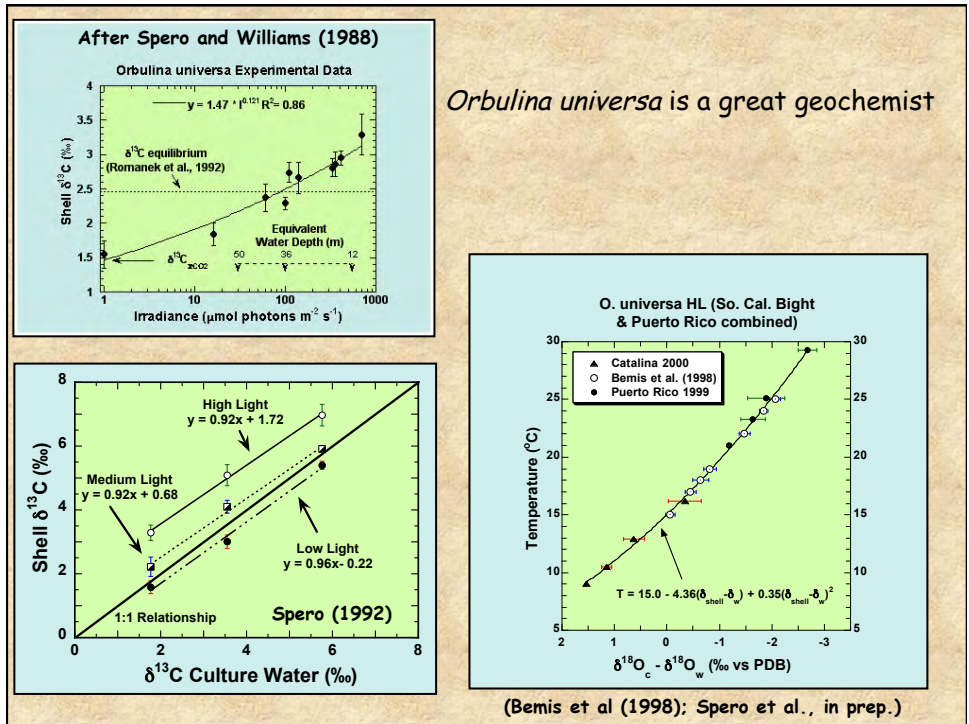


Post-gametogenic *O. universa* shell from the laboratory is identical to a million year old fossil. All extant planktic foraminifera follow this development pattern, but non-spinose species do not shed spines.



Crack the sphere open and the trochospiral shell is still evident inside; note sphere thickness (~20-30 μm)

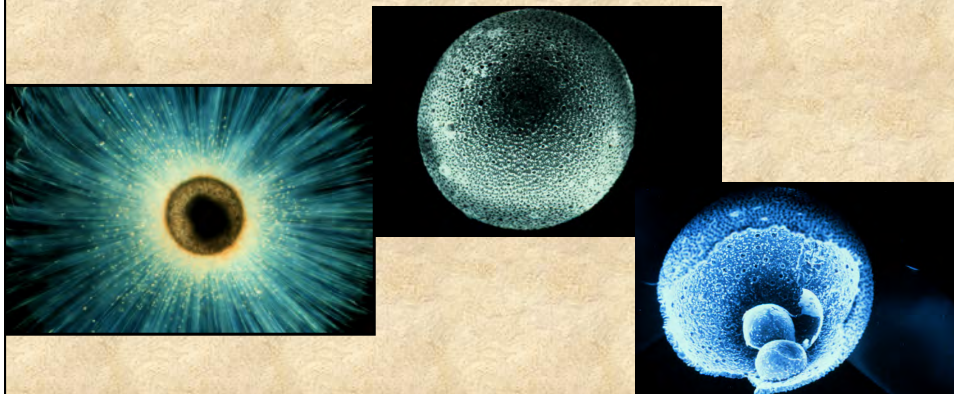




How small can we go.....

**Isotopic and Elemental Analysis of Individual Microfossils:
A Submicron view of Climate and Environmental Change**

Ph.D. Project by Lael 'Spider' Vetter, UC Davis

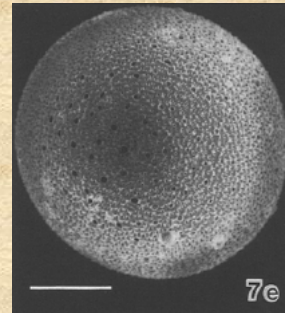


Orbulina universa in culture and after reproduction

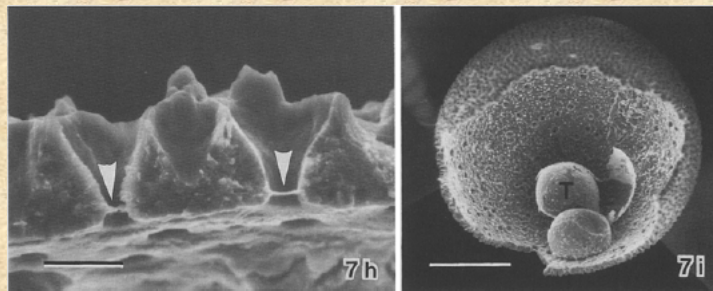
- The next generation of paleoceanographic questions:
- Can we reconstruct depth migration in a single foraminifera shell?
- Do foraminifera contain geochemical information related to short duration storm events or surface salinity change?

Can we get around the diagenetic problem in fossil foraminifera?

SIMS and LA-ICPMS help answer the question



Cross-section through *Orbulina universa* shell



(Spero 1988)

Univ. Wisconsin SIMS - Cameca 1280



Spider Vetter,
Claudia Mora and
Reinhard Kozdon
analyzing cultured
foraminifera

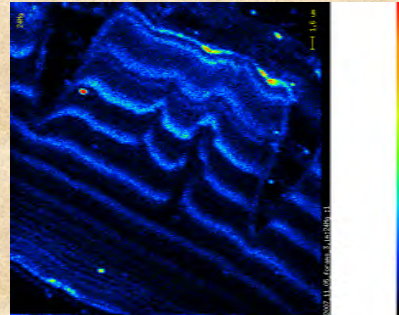
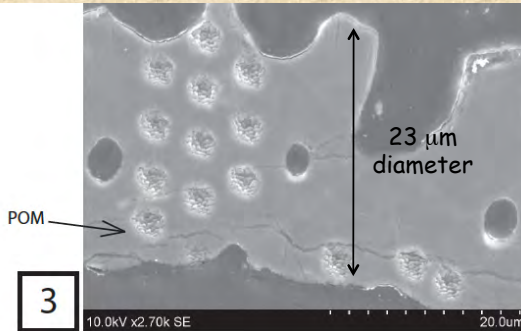


U. Wisconsin SIMS

SIMS analyses through an *O. universa* chamber - can we resolve $\delta^{18}\text{O}$ shifts at this resolution?

Ion microprobe spots across *O. universa* chamber (2x3 mm)

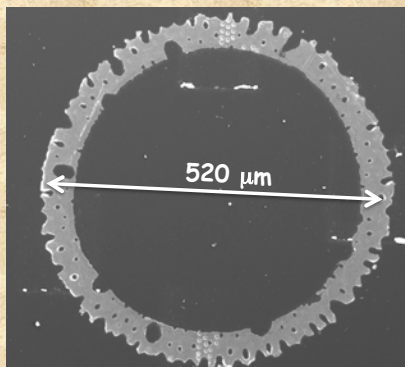
NanoSIMS image from a different *O. universa* showing Mg banding



SIMS analyses were conducted at the University Wisconsin with R. Kozdon and J. Valley); nanoSIMS image was generated at University of Perth (Kilburn) (Vetter, unpublished data)

SIMS (secondary ion mass spectrometry) through an *O. universa* chamber - $\delta^{18}\text{O}$ analyses with 2-3 μm resolution

Cross-section through *O. universa*



Vetter et al, 2013

