The effects of human impact and natural climate variation in the LakeTahoe Basin, California, USA

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Lake Tahoe

- largest alpine lake in North America
- known for exceptional clarity
- major tourist destination

1860's Comstock era in Tahoe basin

- Timber needed for silver mining
- Extensive logging
- Smelting activites

Spooner Summit, 1876

Regional environmental history

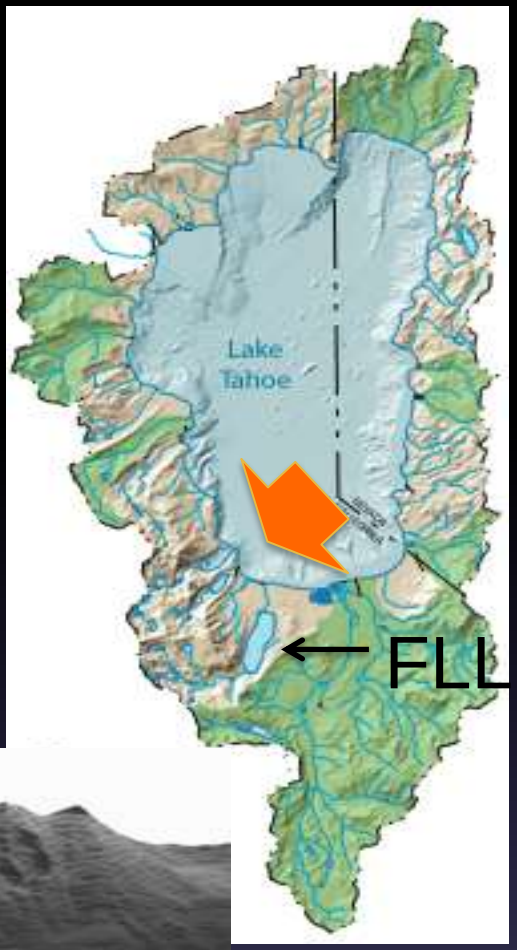
- 1860's extensive logging
- 1950's rapid expansion of housing developments
- 1970's lake clarity declines

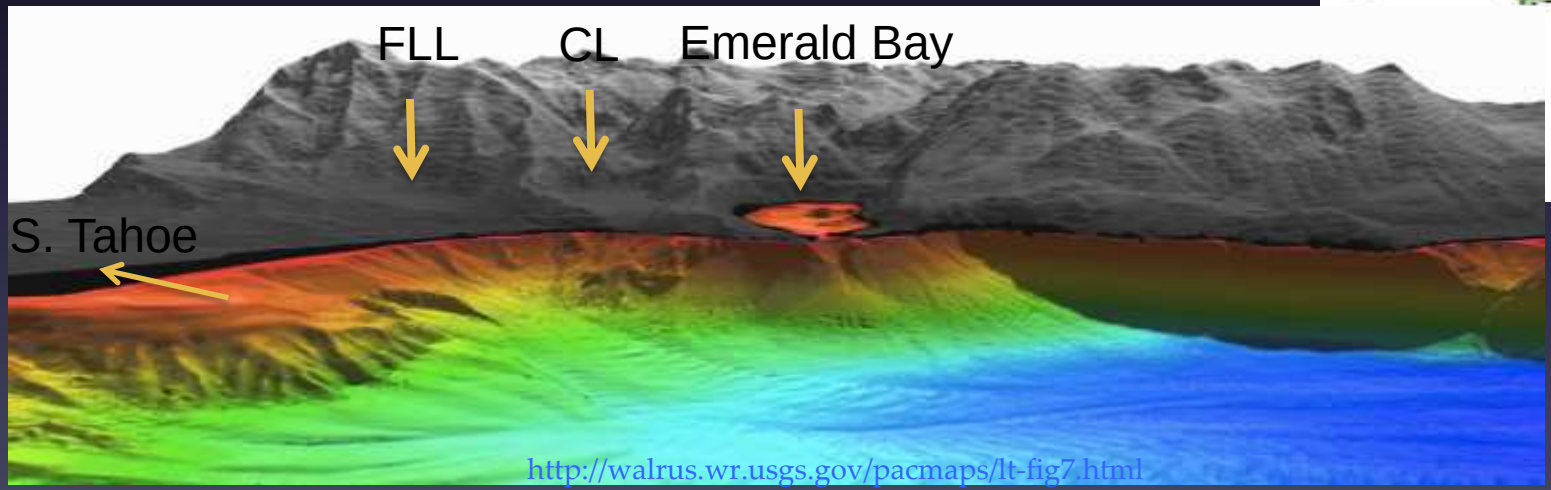

Tramway near Incline Village 1885


Tahoe Keys development built in 1950's

Fallen Leaf Lake (FLL)

- 1950 m elevation, 120m deep, 70 mean depth
- Sediment core study
- Smaller, less complex lake. better archive of environmental change

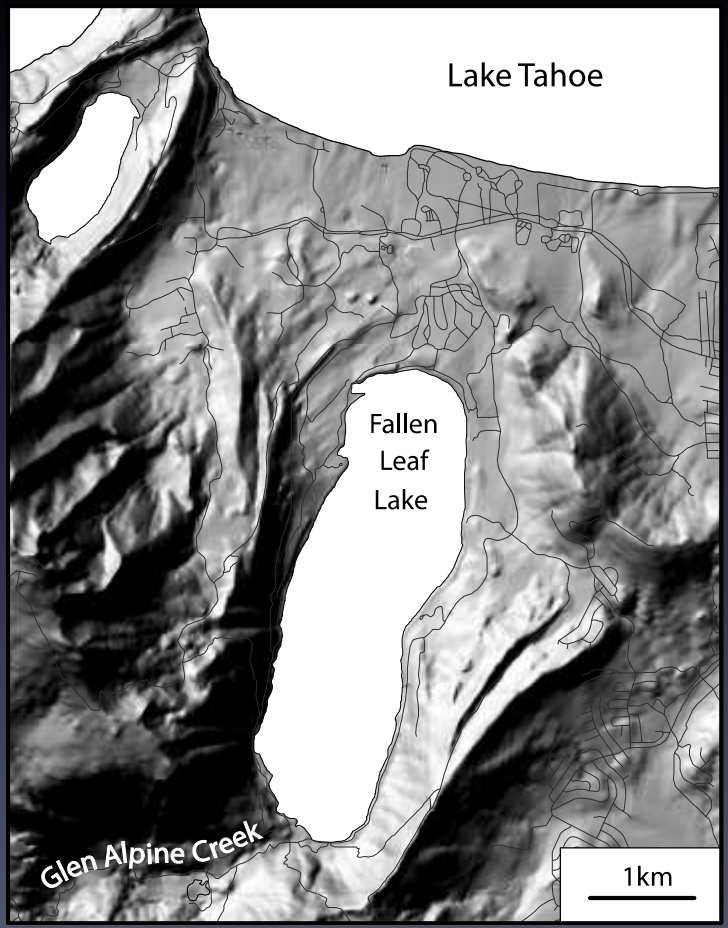




Oblique shaded relief bathymetric map southwest margin of Lake Tahoe

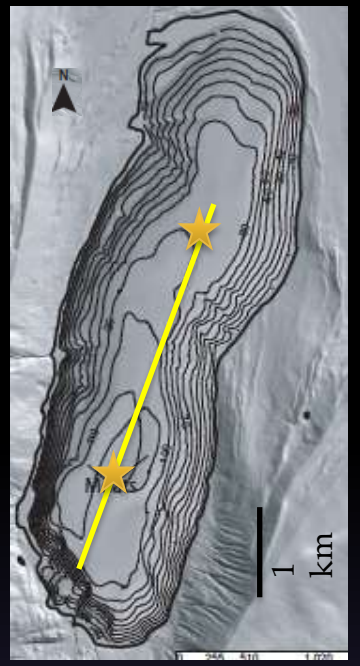
Fallen Leaf Lake – Origin:

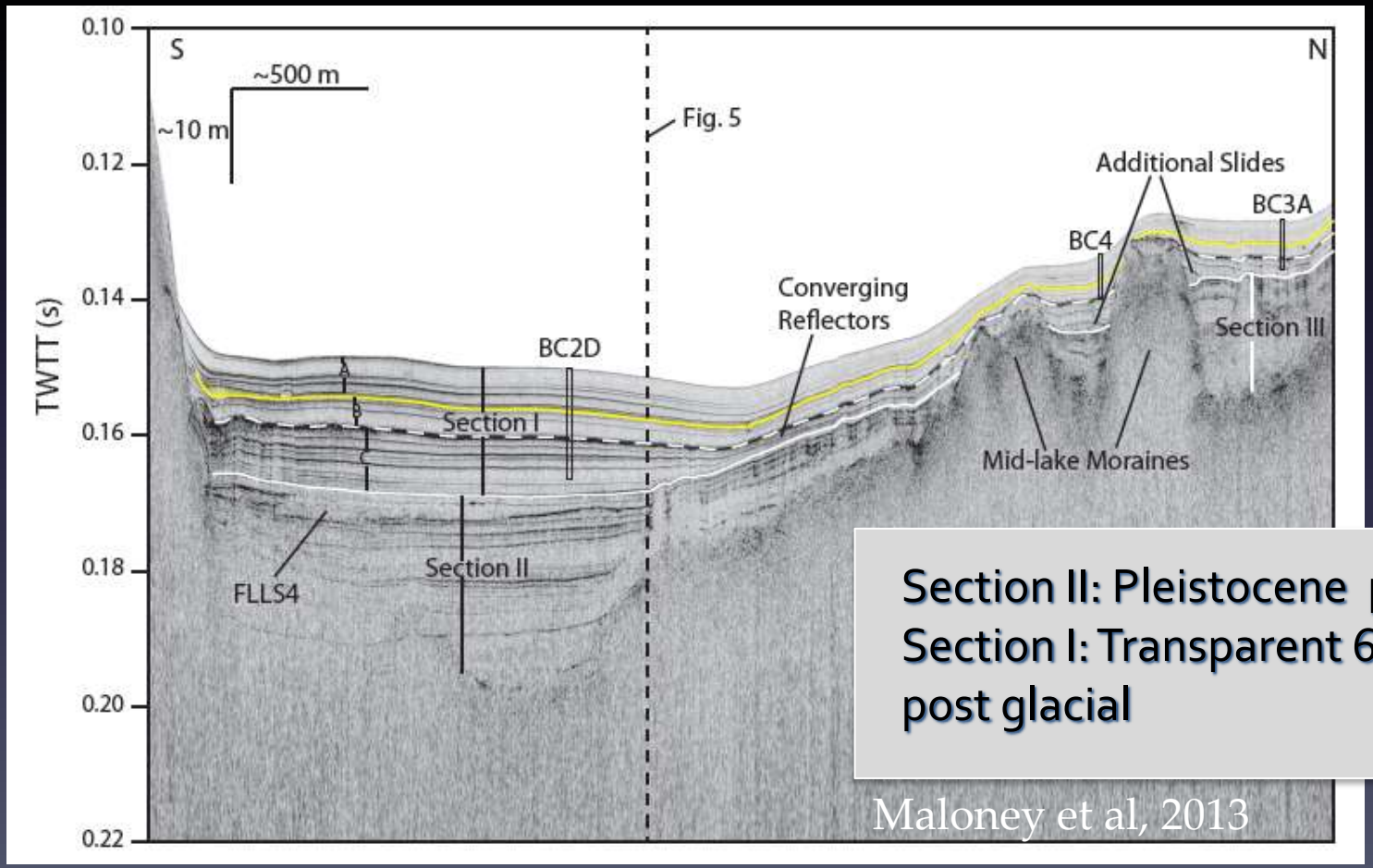
- Glacial, following Late Tioga glacial retreat (14-15 thousand years old)
- Fills steep valley
- Northern end dammed by ridges of glacial deposits



Geophysical work delineates stratigraphy

- Southern sub-basin deeper, thicker sediment
- Northern sub-basin – lake sediment pockets between ridges of glacial debris



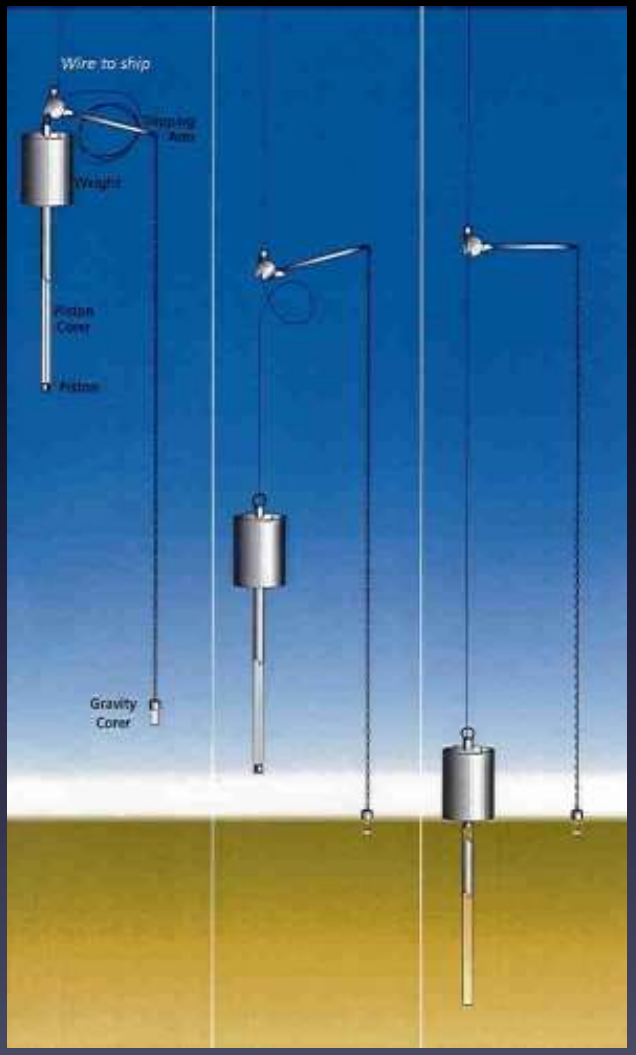


Section II: Pleistocene periglacial
Section I: Transparent 6-15 m thick post glacial

Maloney et al, 2013

How do we take cores in deep lakes?

Kullenberg Piston and gravity coring system



http://oceanworld.tamu.edu/students/forams/forams_piston_coring.htm

LacCore.org National Lacustrine Core Facility

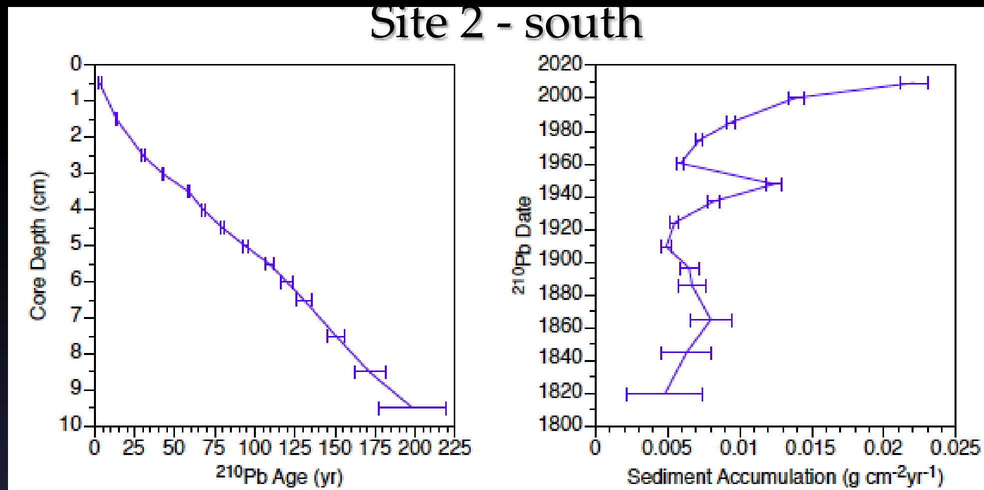
High resolution record from gravity cores

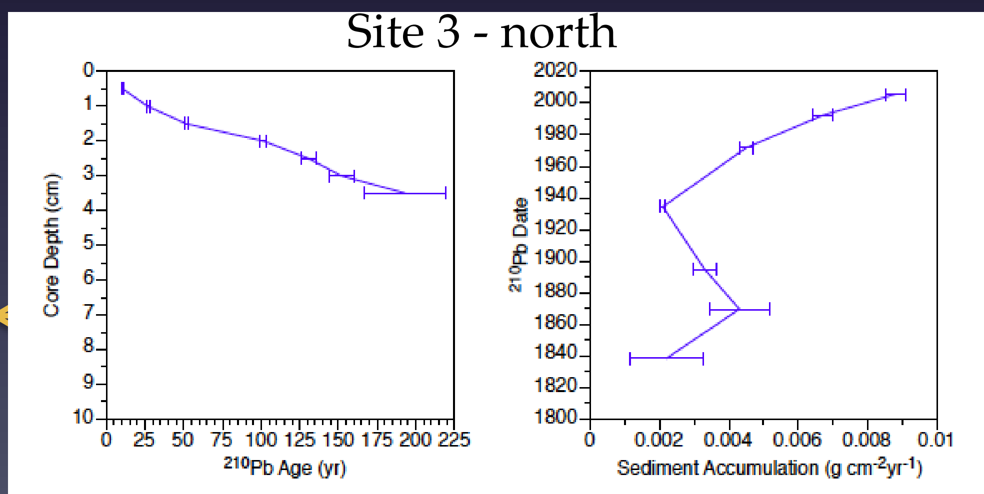
Analyses:

- Age model (^{210}Pb)
- Elemental geochemistry
- Diatoms

Results: Age model using ^{210}Pb dates last 200 years of the core

Core 2

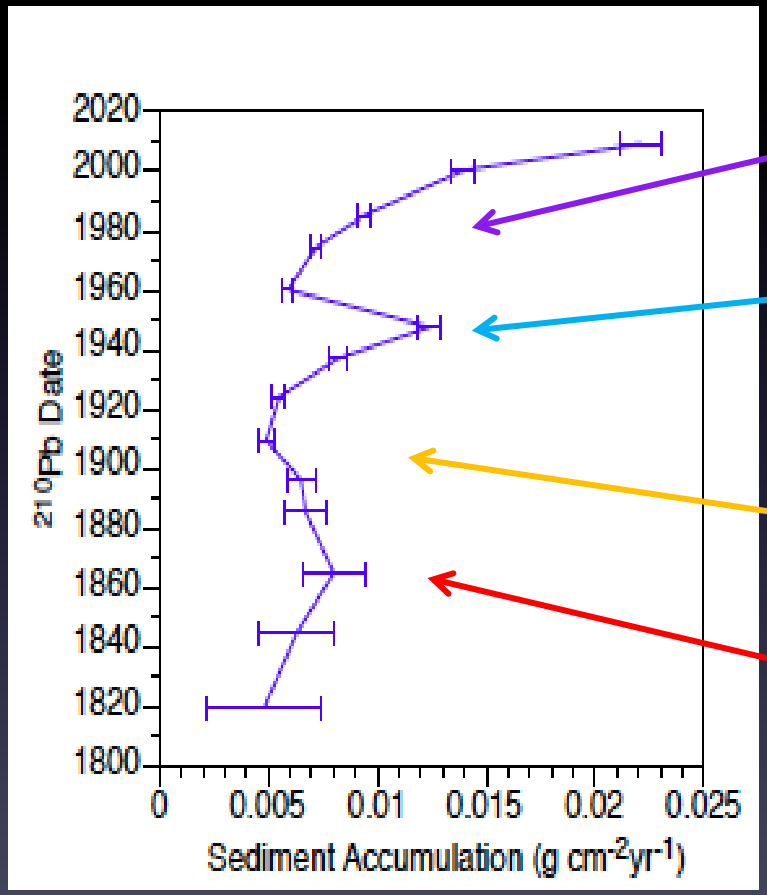




Core 3

Lower Accumulation rate

Sediment Accumulation can relate to anthropogenic activities



1960 – Tahoe winter Olympics – increased development

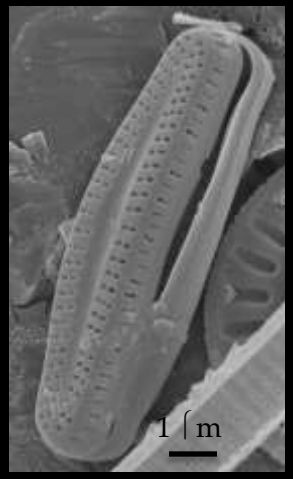
1955 – Storm layer –small dam above lake washed away

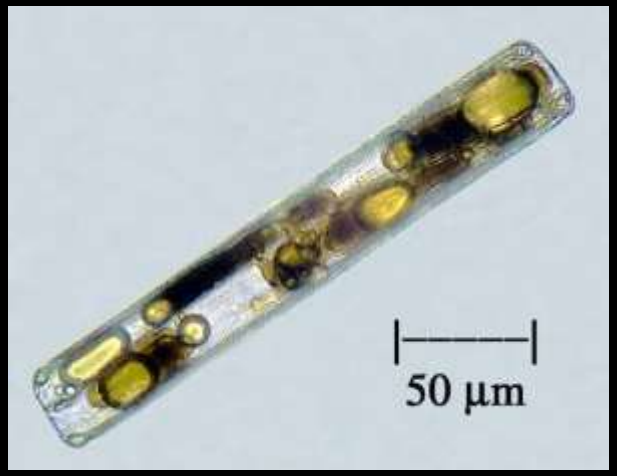
1905 – USFS permits for cabin building issued

1861 – Comstock mining era. Nathan Gilmore brought cattle to FLL

Site 2: Southern sub-basin

Diatoms



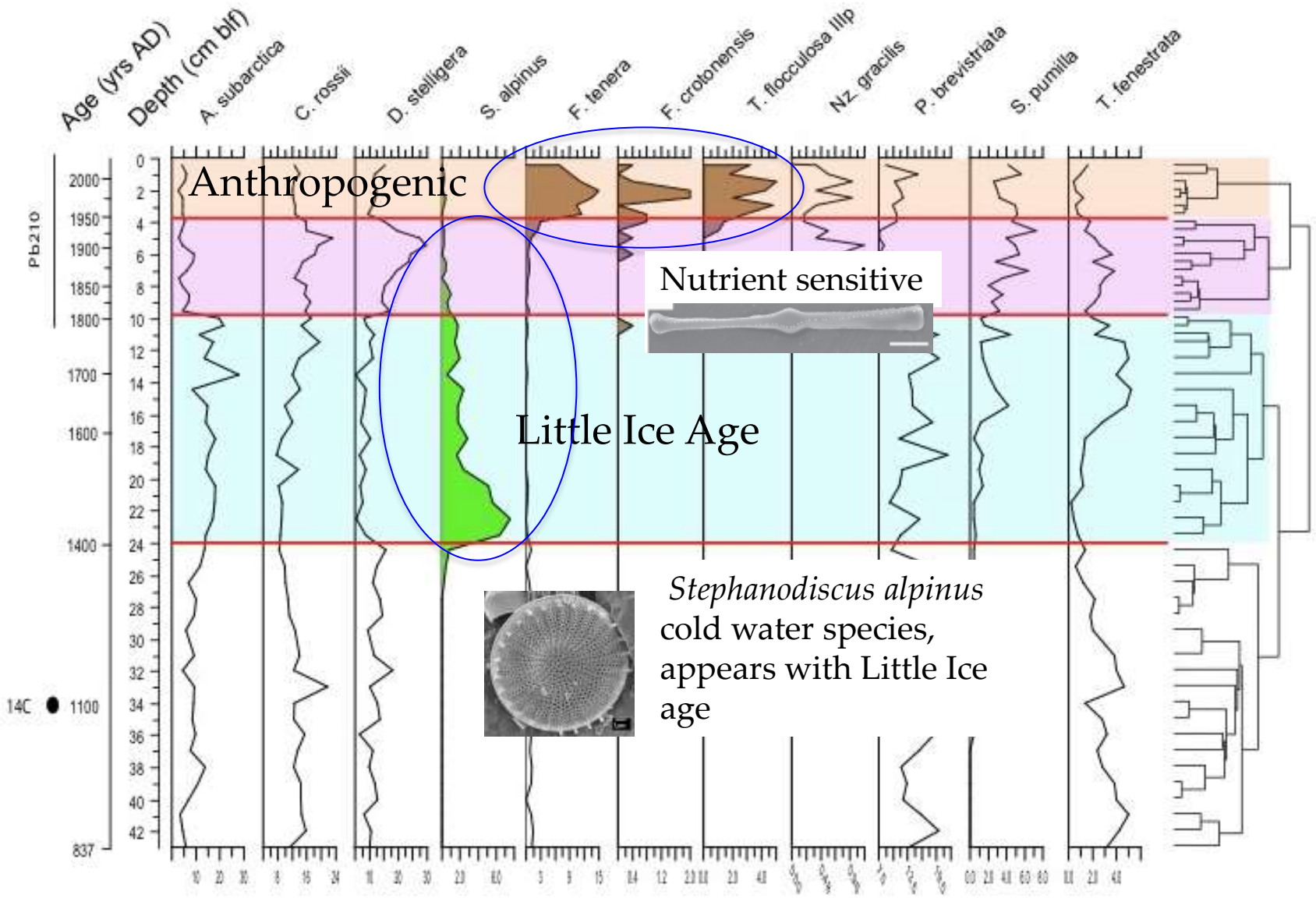


- Unicellular golden algae, with skeleton of opal silica and live in all aquatic environments
- Used to reconstruct past conditions, sensitive to changes in temperture, nutrients, pH, salinity, alkalinity

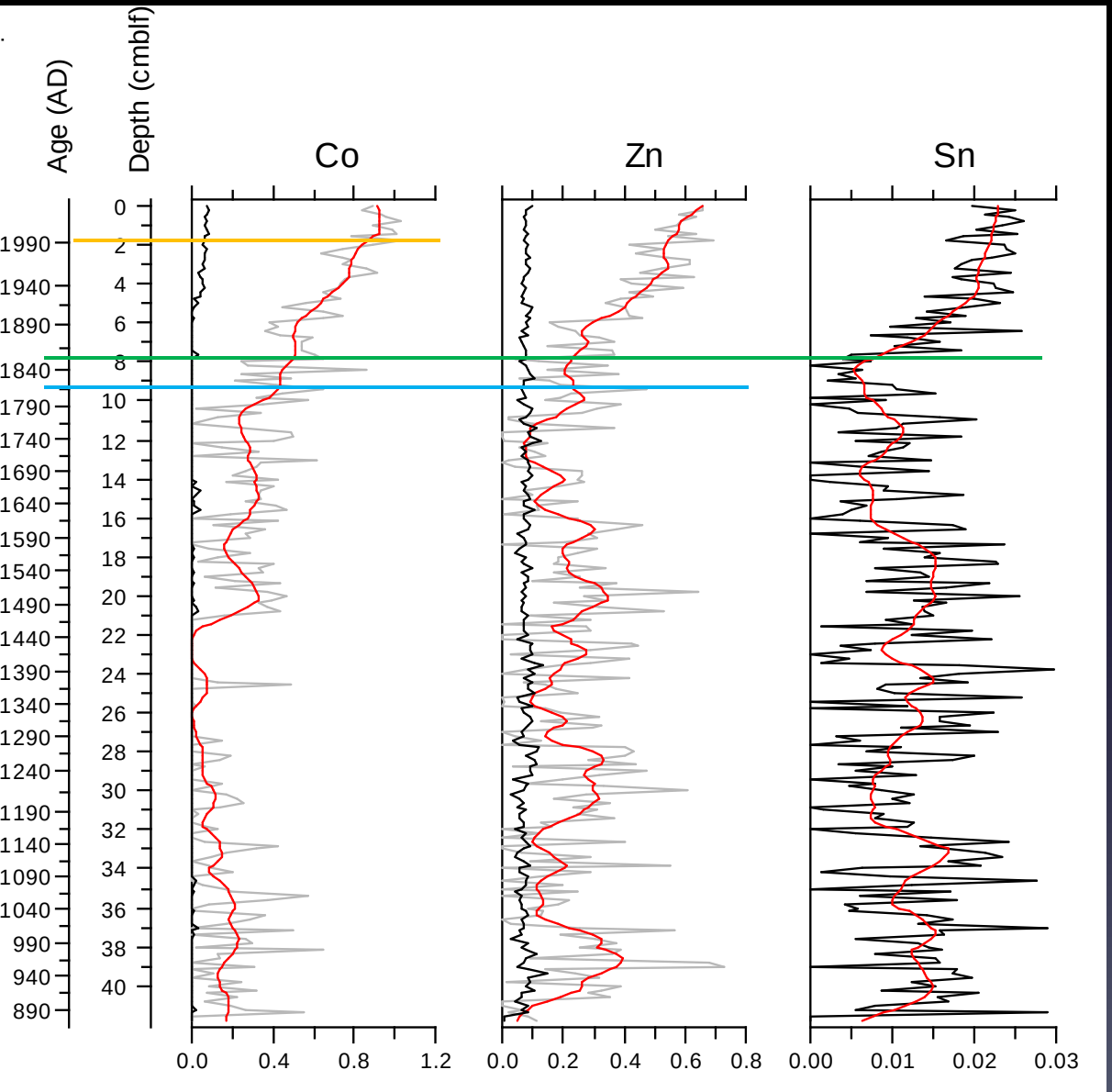
Diatom results

- Species abundance: based on counting 500 diatoms on glass slide mounts for each of 54 samples.
- 181 species, but many were rare
- 24 taxa >2% of a sample

Diatoms –species abundance counts for core 2.



Elemental geochemistry: Atmospheric Deposition of Trace Metals



Metal Ore Smelting ~1820

- Cobalt-Co & Zinc-Zn
  Eureka, NV
  Shasta County, CA

Co decreases ~1990

- with Clean Air Act

Coal Combustion ~1850

- Tin-Sn
- 5-20% of global Sn emissions are from coal combustion
- California Gold Rush coincides with Sn increases

Gravity core Summary

We can see environmental and climatic influences on the Fallen Leaf Lake sediment record.

- **1400-1800: Little Ice Age,** represents cooling , increased cold water diatom species

- ~1800-1950: Transitional zone, **increases in Cobalt, Zinc and Tin in lake sediments - evidence of metal ore smelting and coal combustion associated with mining and logging activity**

- **1950 – 2010: Anthropogenic Zone,** represent increased land-use, largest change in plankton community and sedimentation rates

Acknowledgements

Funding from the NATIONAL SCIENCE FOUNDATION grant EAR 1247499.

Thanks to Graham Kent, Neil Driscoll, and Jillian Maloney (Scripps, NSL) for providing CHIRP data, Anders Noren and Christina Brady (LacCore) for help coring, and our UNR colleagues and students for help and logistic support: Bob Karlin, Laurel Stratton, Shane Smith, Annie Kell, Amy Eisses, Jon Payne, and Josh Michaels.

University of Nevada, Reno

LacCore.org National Lacustrine Core Facility

CAMS

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