

Hydrological Variability In Chilean Altiplano Lakes during the Last Millennia



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Laboratorio Internacional de Cambio Global LINCG

Universidad de Vigo



75 AÑOS

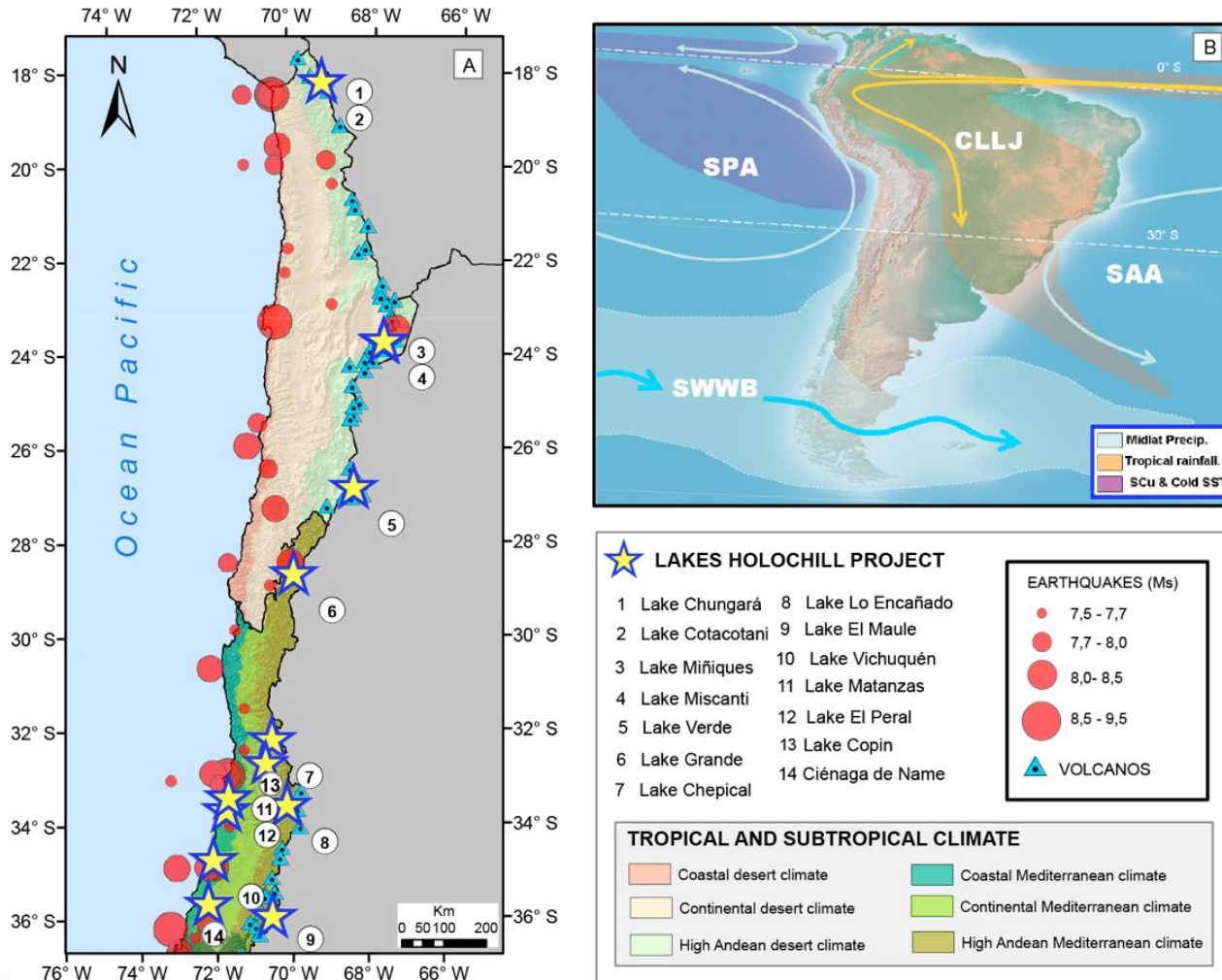


IEB CHILE

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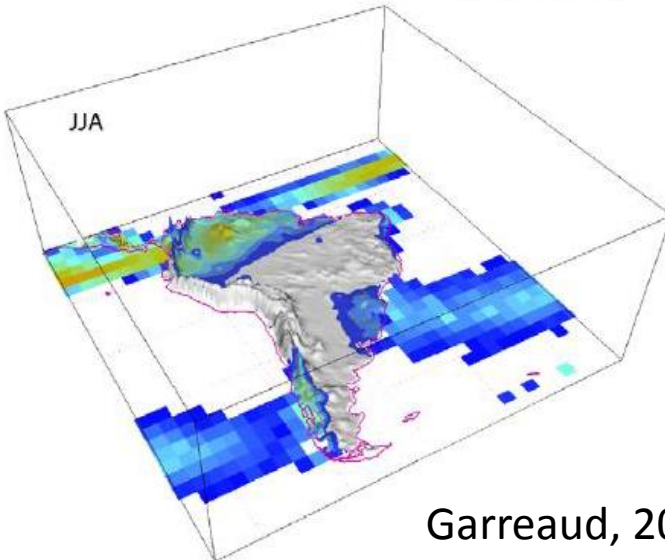
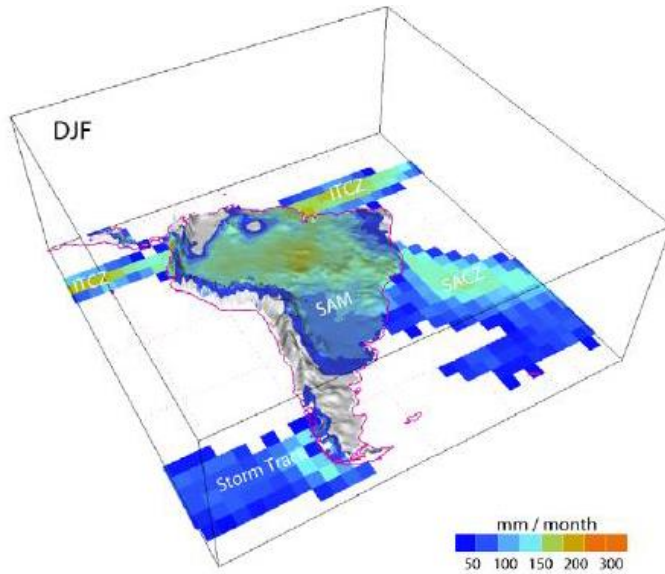


The Chilean Altiplano

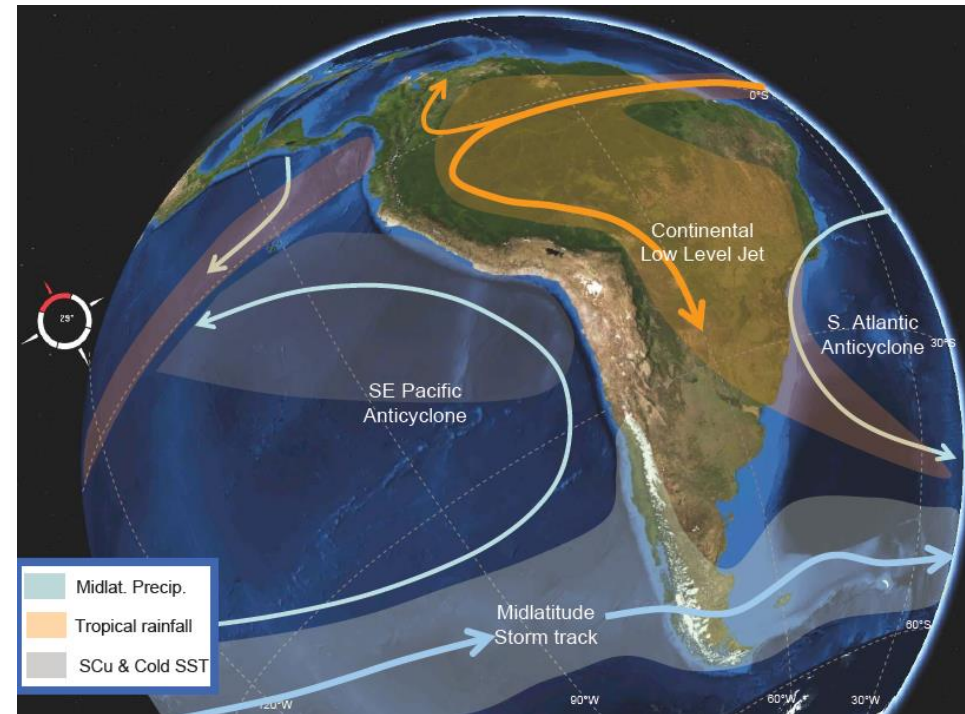


- Active volcanism and earthquakes
- A strong latitudinal climate gradient
- The driest desert: Atacama

Climate



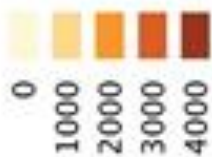
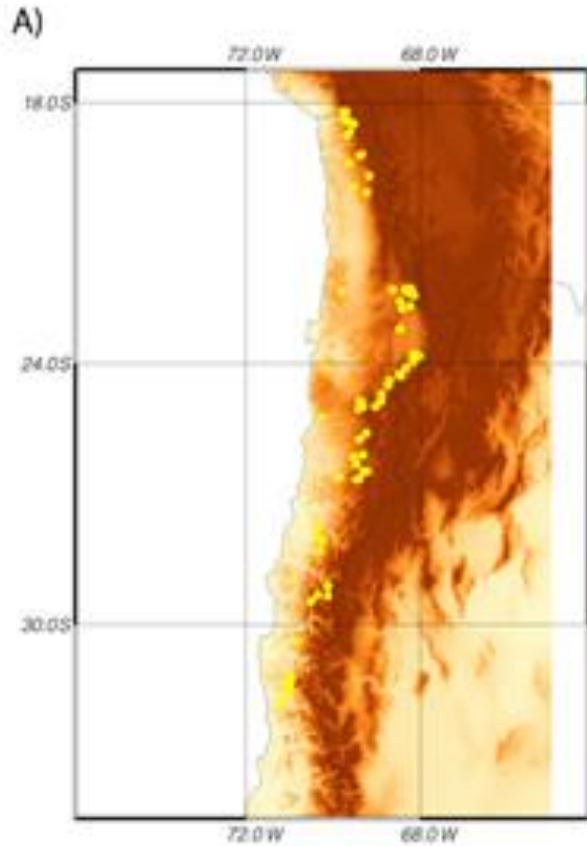
Garreaud, 2009



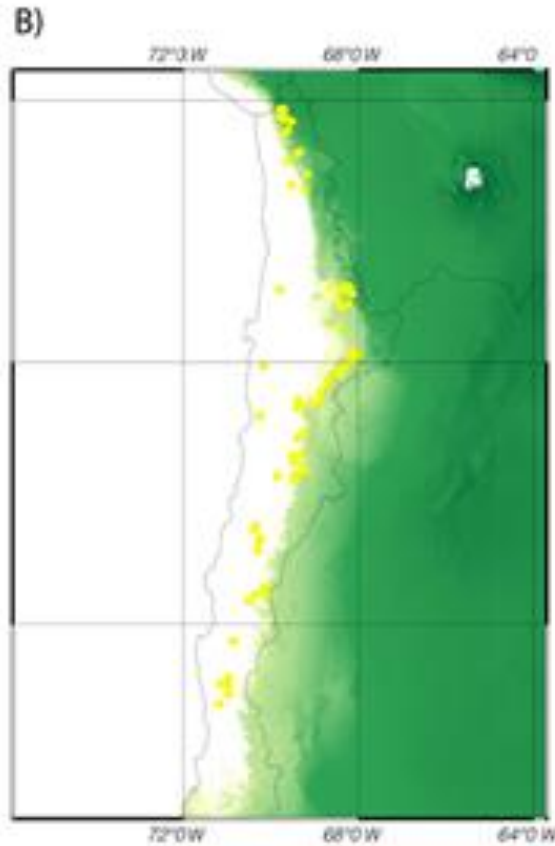
- South American Summer Monsoon
- South Pacific Anticyclone (SPA)
- Southern Westerly Belt
- Andean Mountain effect

Spanning a sensitive transition → the rainfall divide along the “arid diagonal”

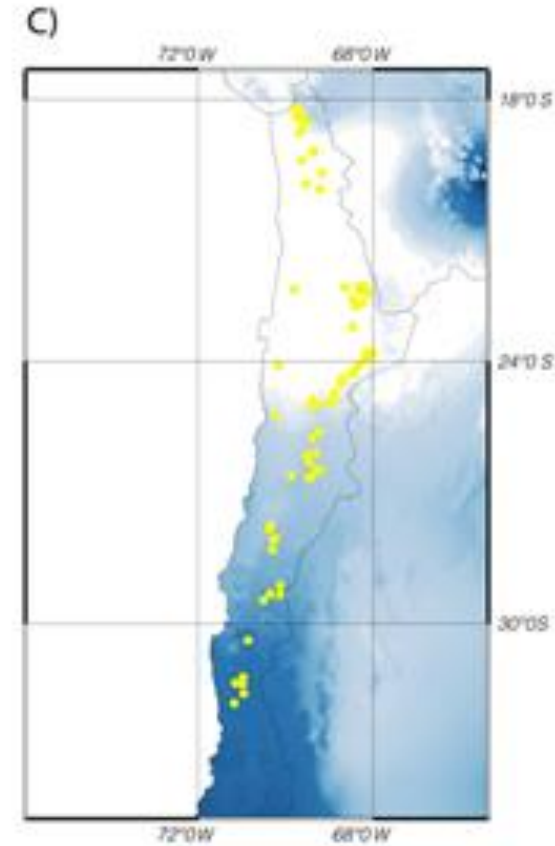
DEM



Summer rainfall

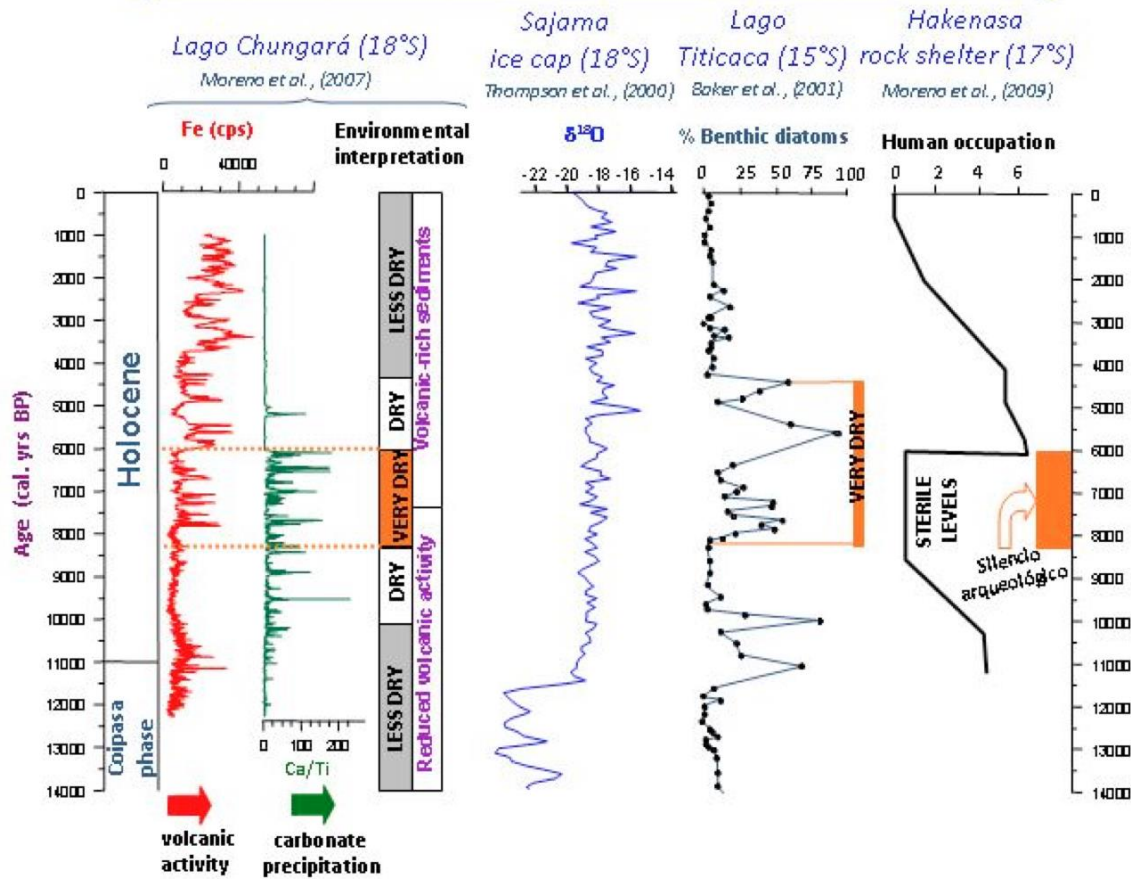


Winter rainfall

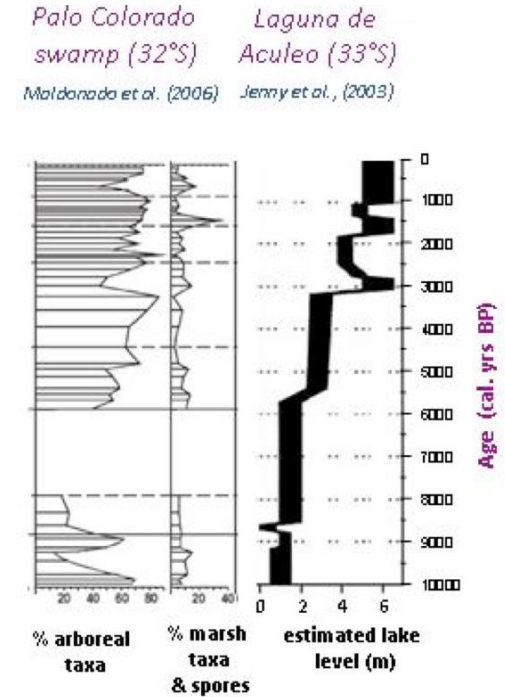


Altiplano vs Central Chile

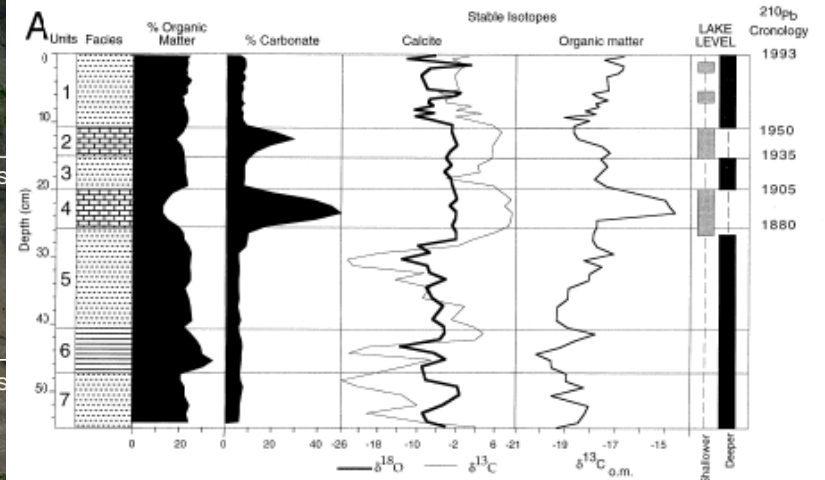
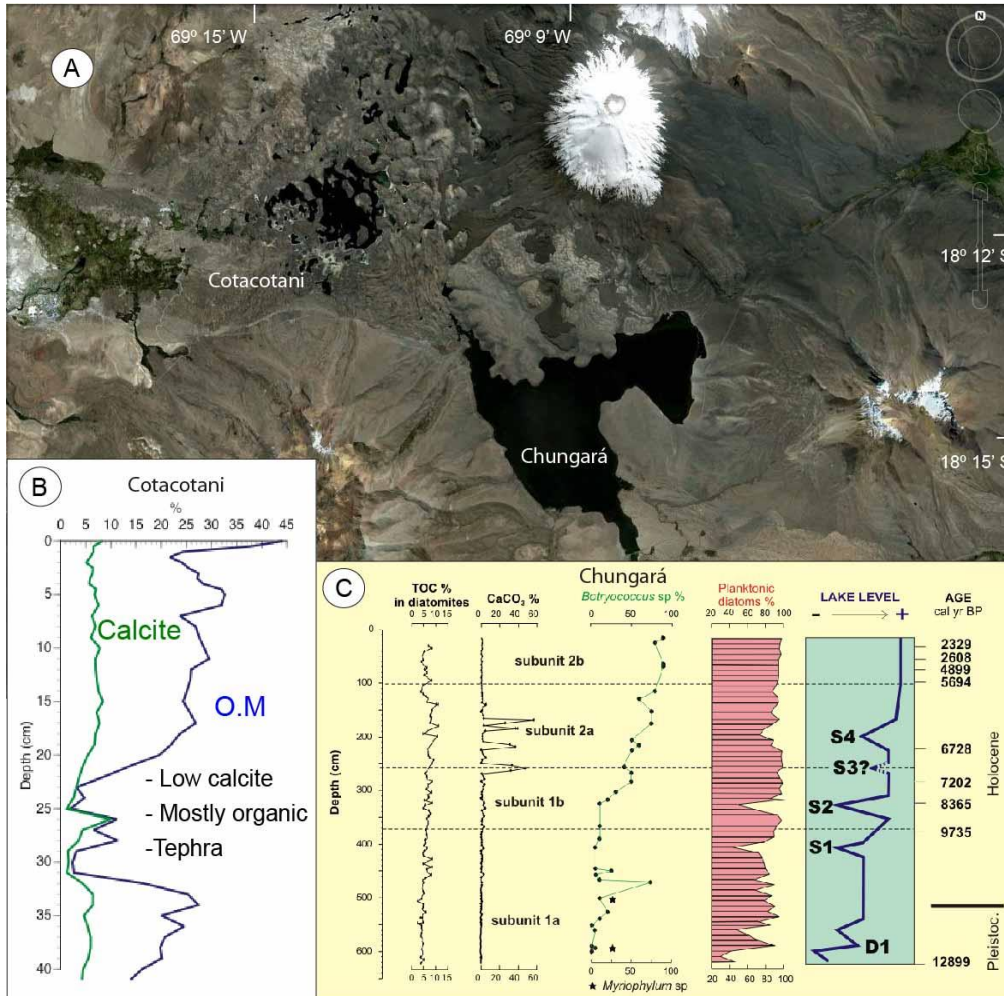
ANDEAN ALTIPLANO



CENTRAL CHILE



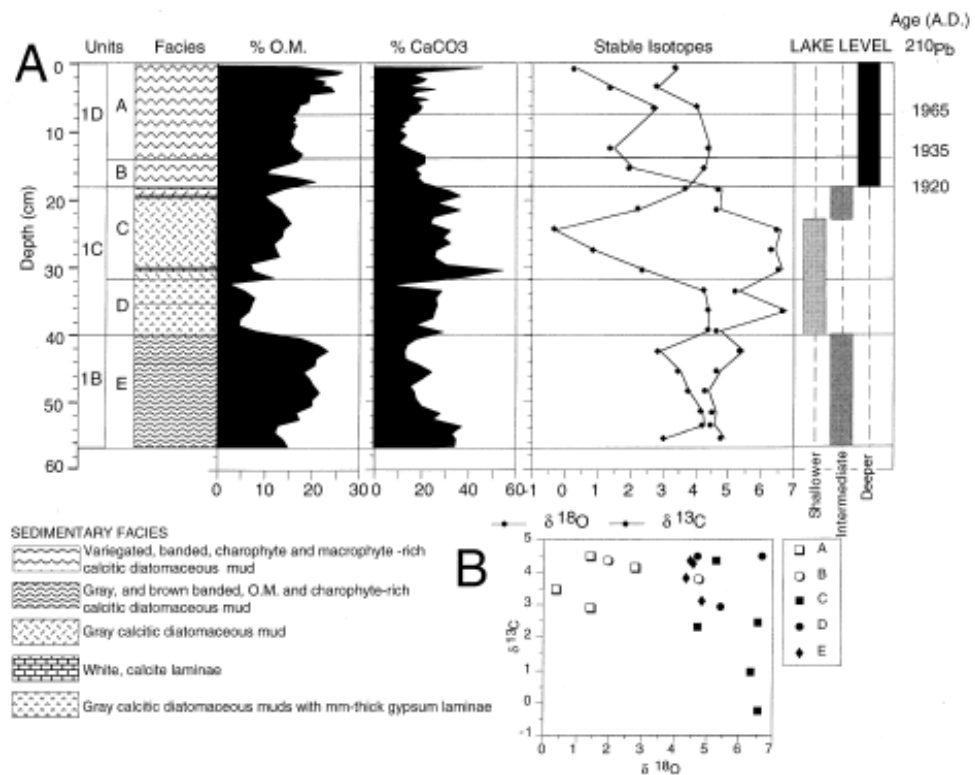
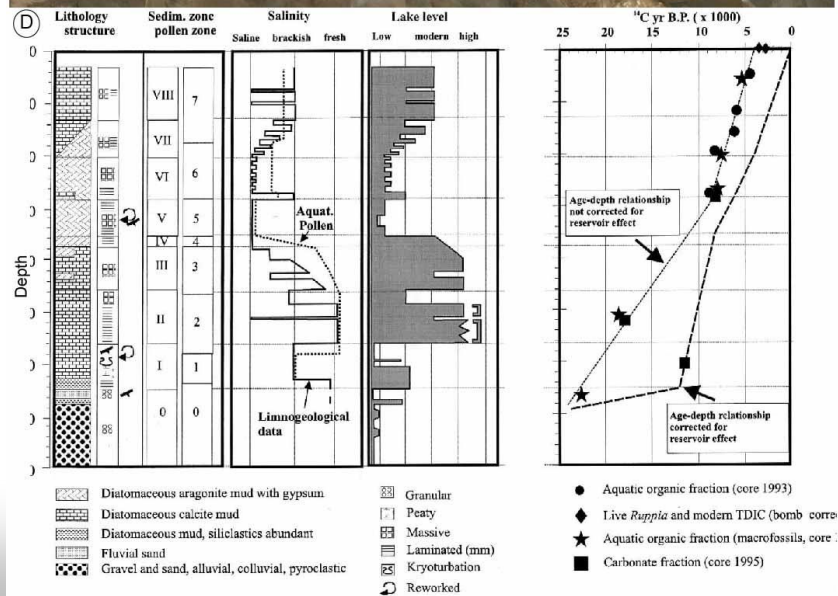
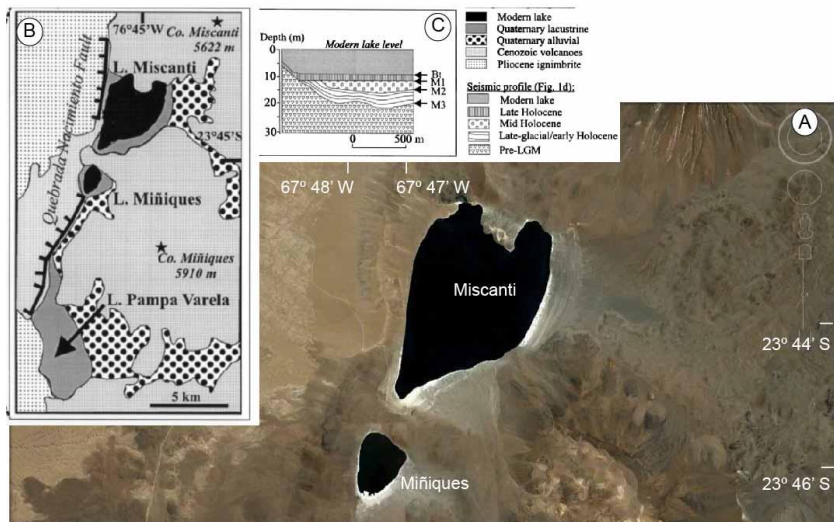
Chungará Record (18 15 S)



A wet LIA

Mid Holocene crises

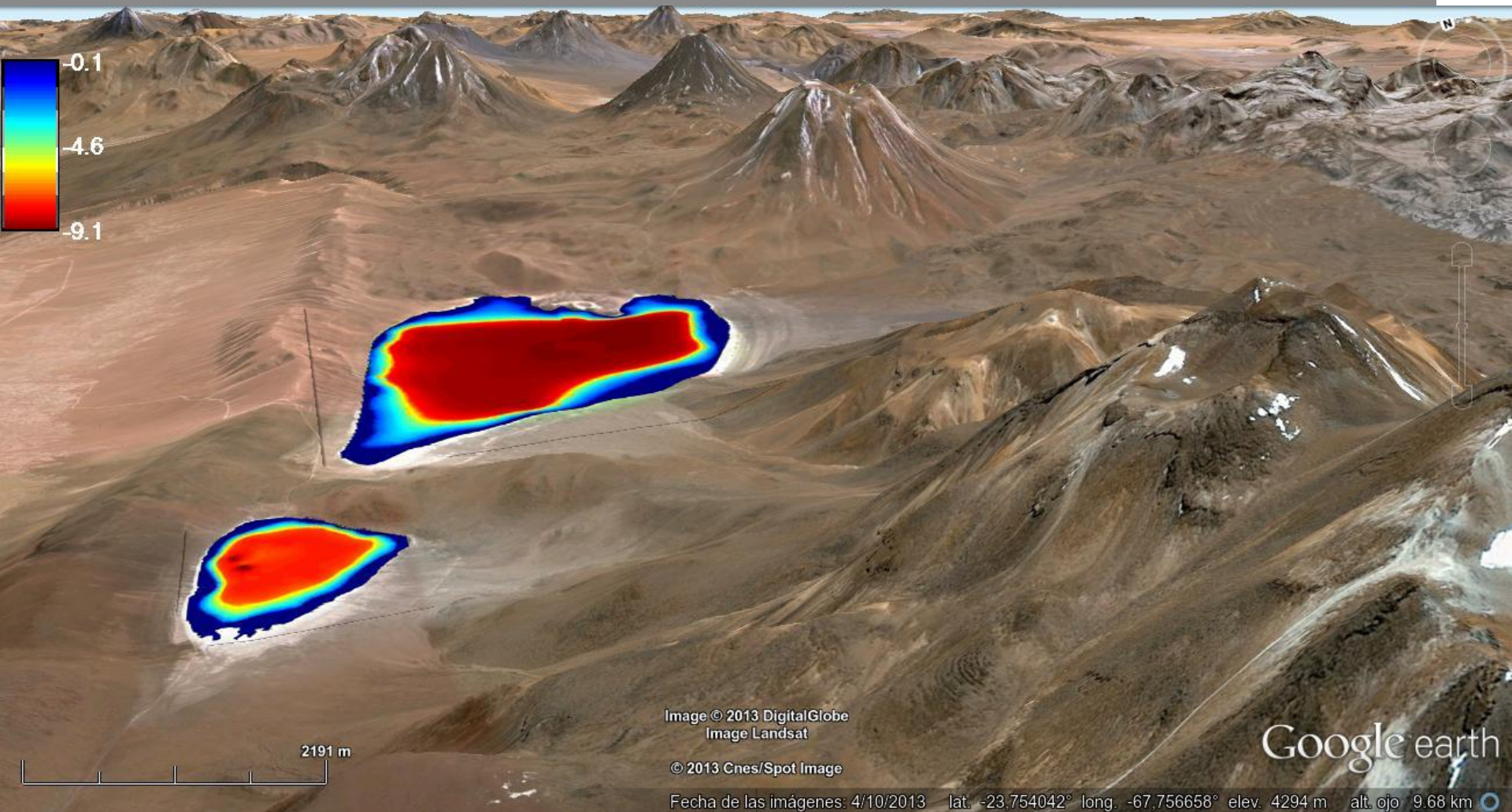
Miscanti Record



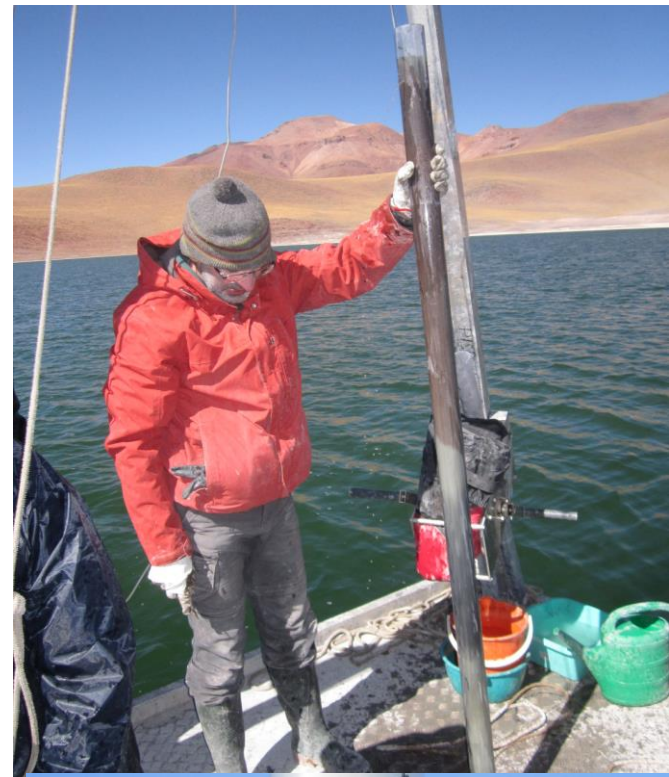
Valero-Garcés et al., 2005

Grosjean et al. 2002

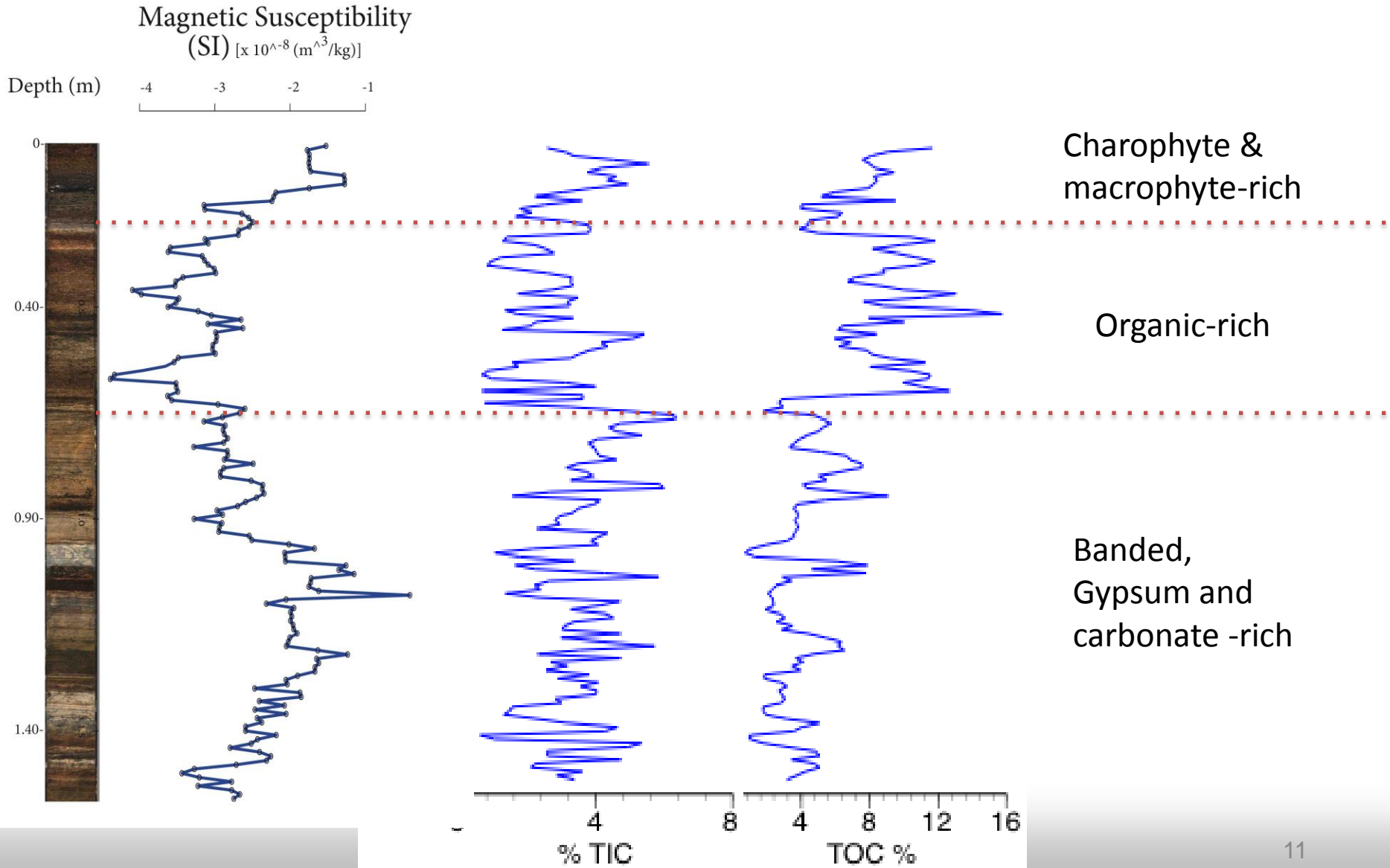
The Atacama Lakes



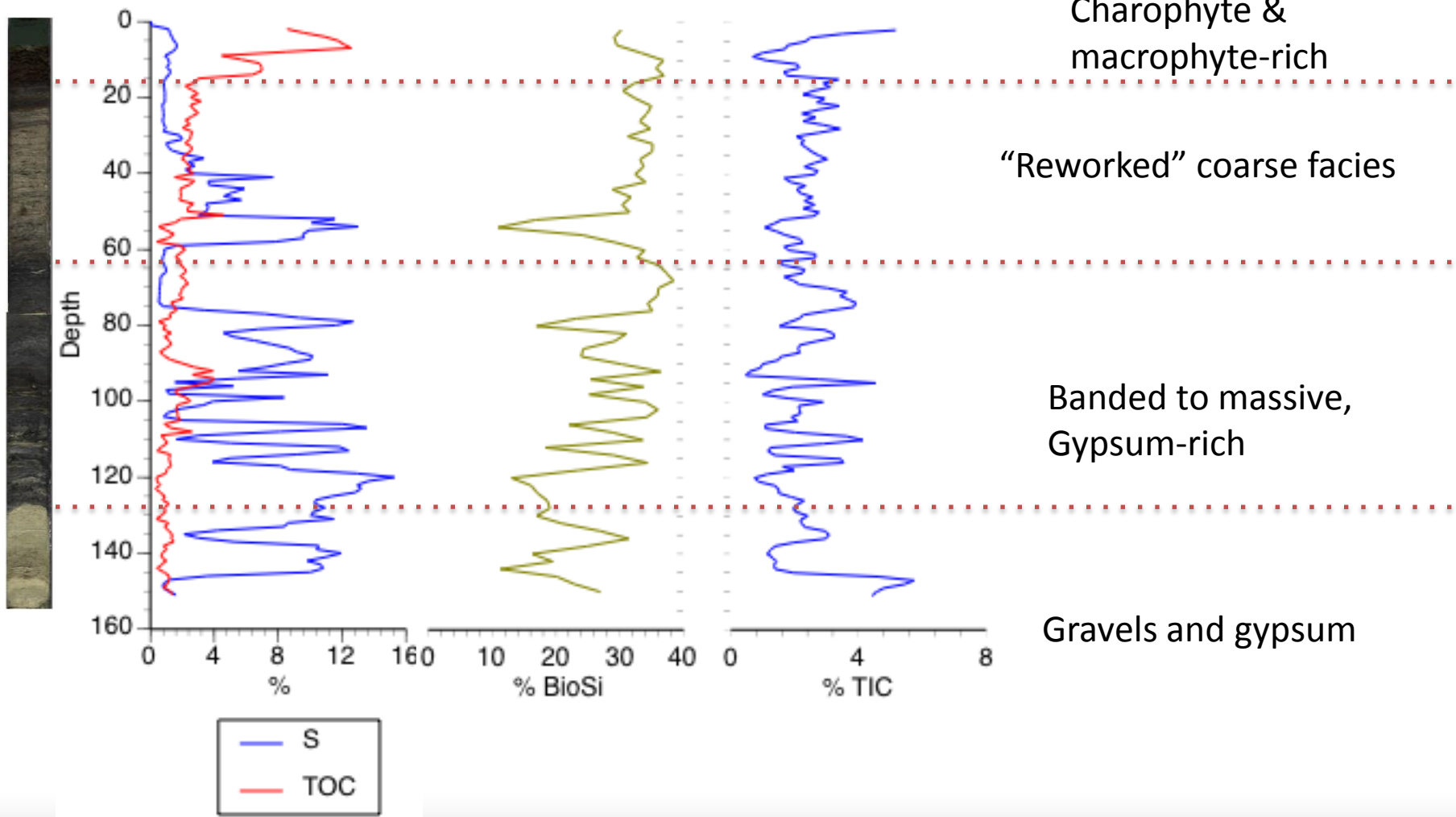




Miscanti

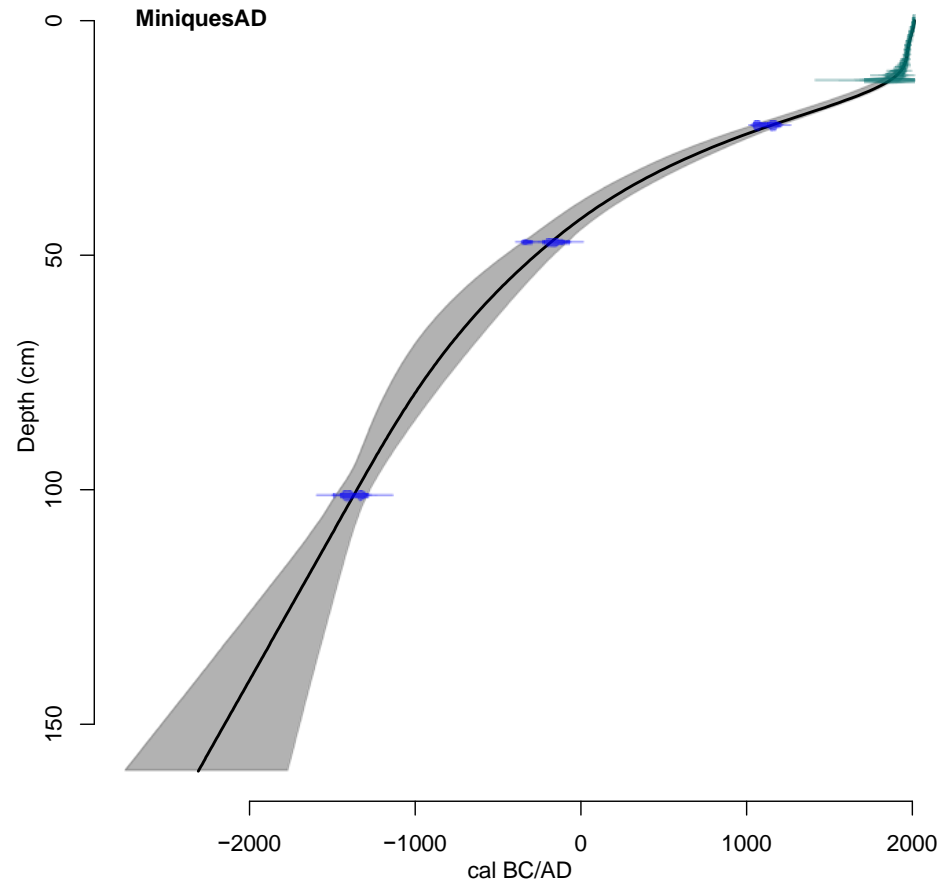
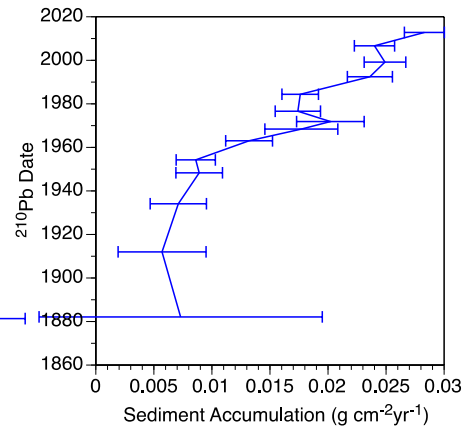
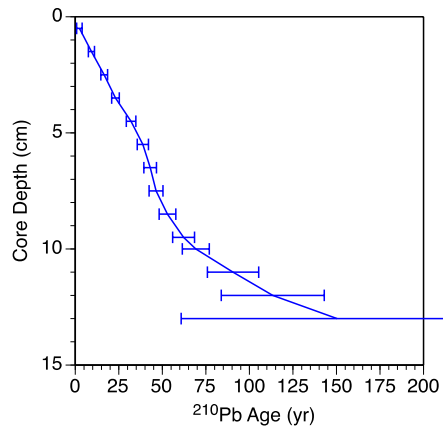
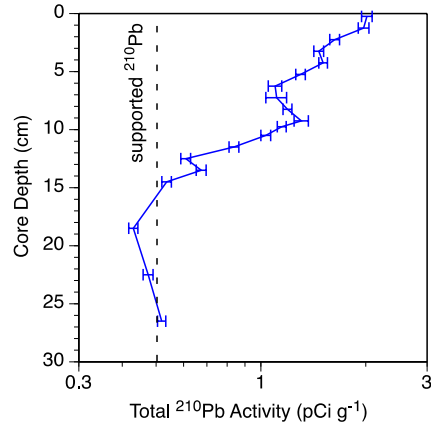


Miñiques



Age model Miñiques

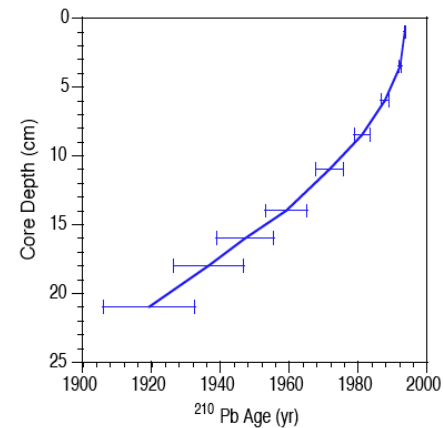
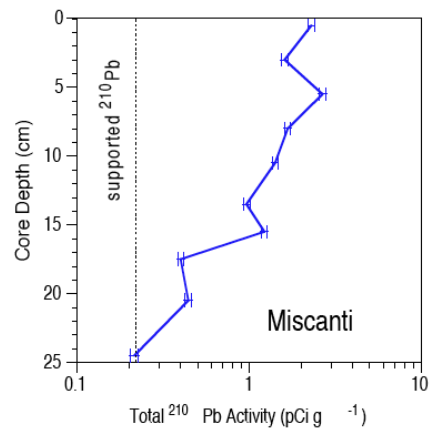
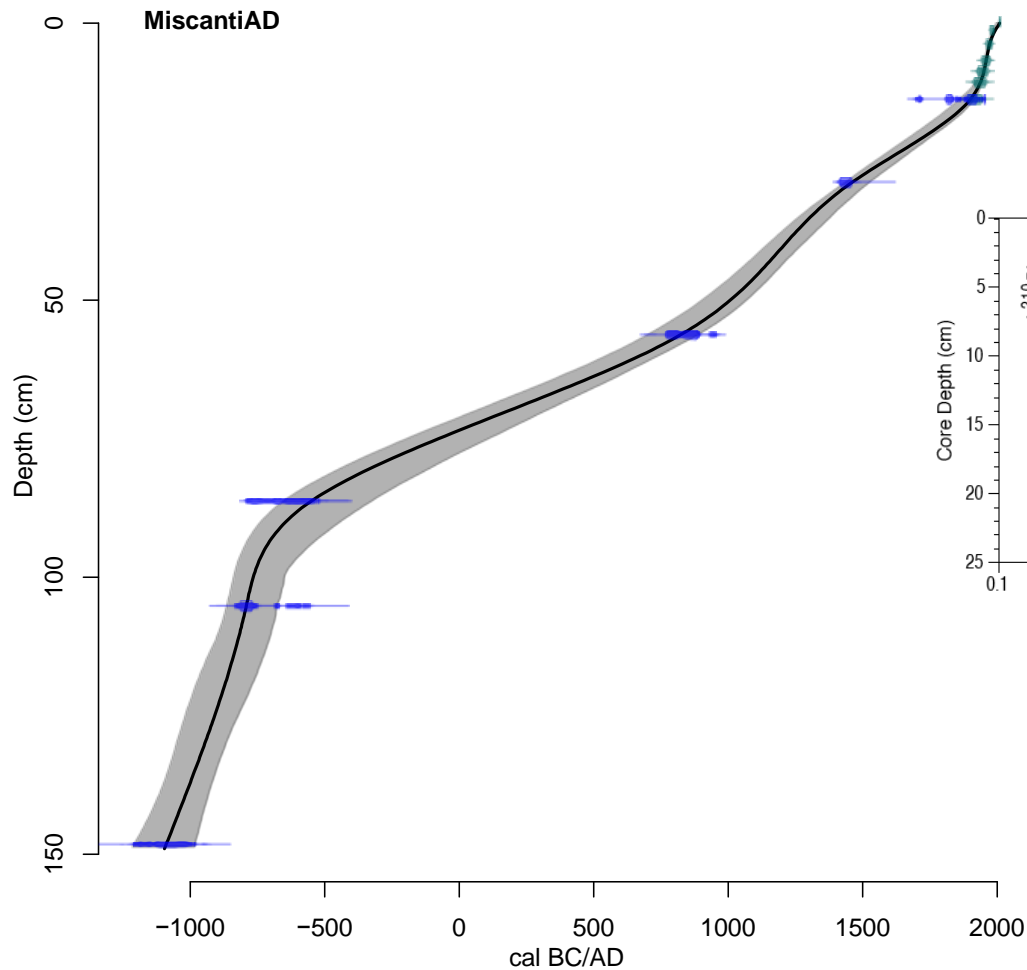
Lago Miñiques, Chile
2013 Core



A 2965 ^{14}C yr reservoir effect

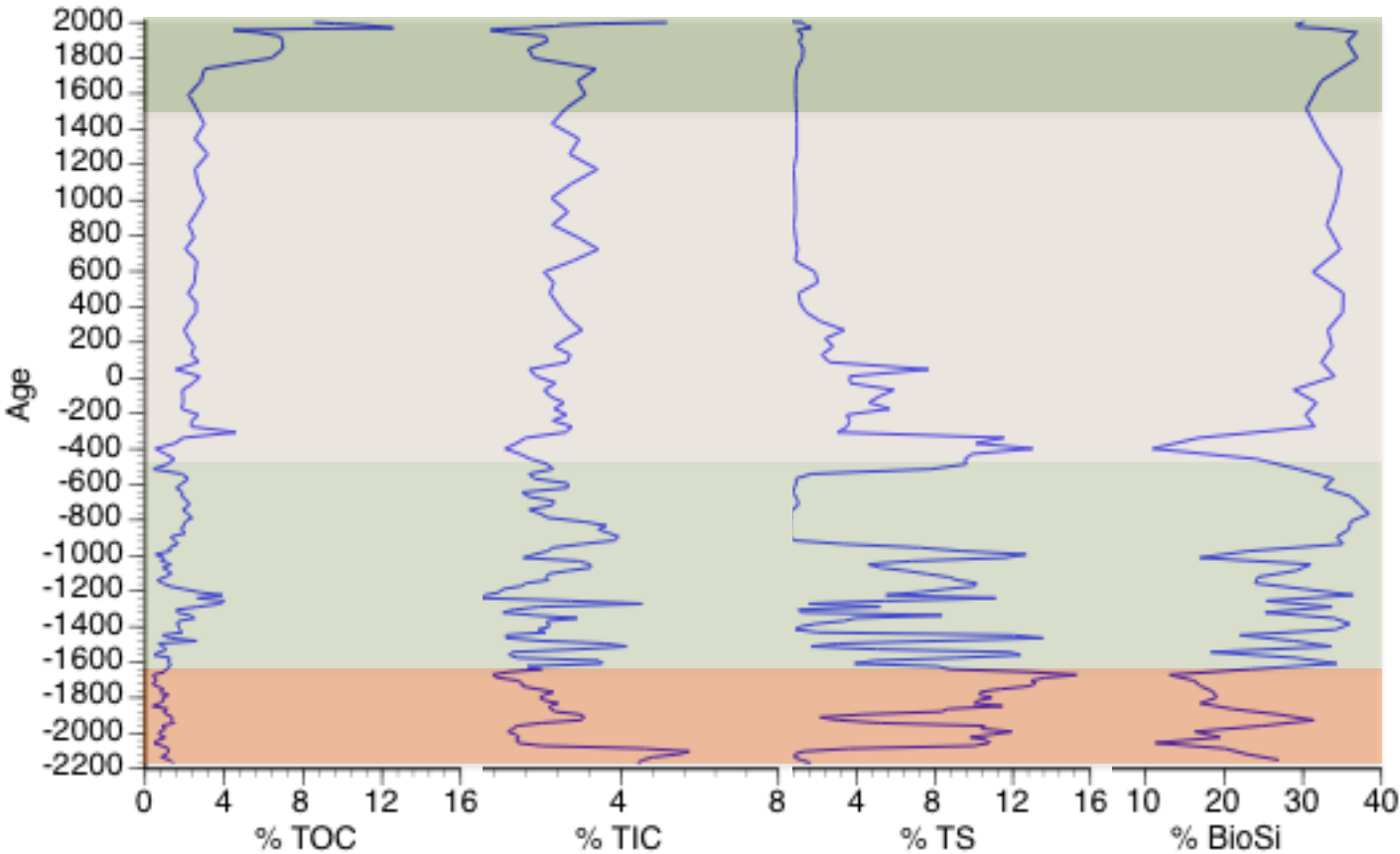
Waiting for U/Th dates!

Age Model Miscanti



A 2370 ^{14}C yr reservoir effect
Waiting for U/Th dates!

Miñiques



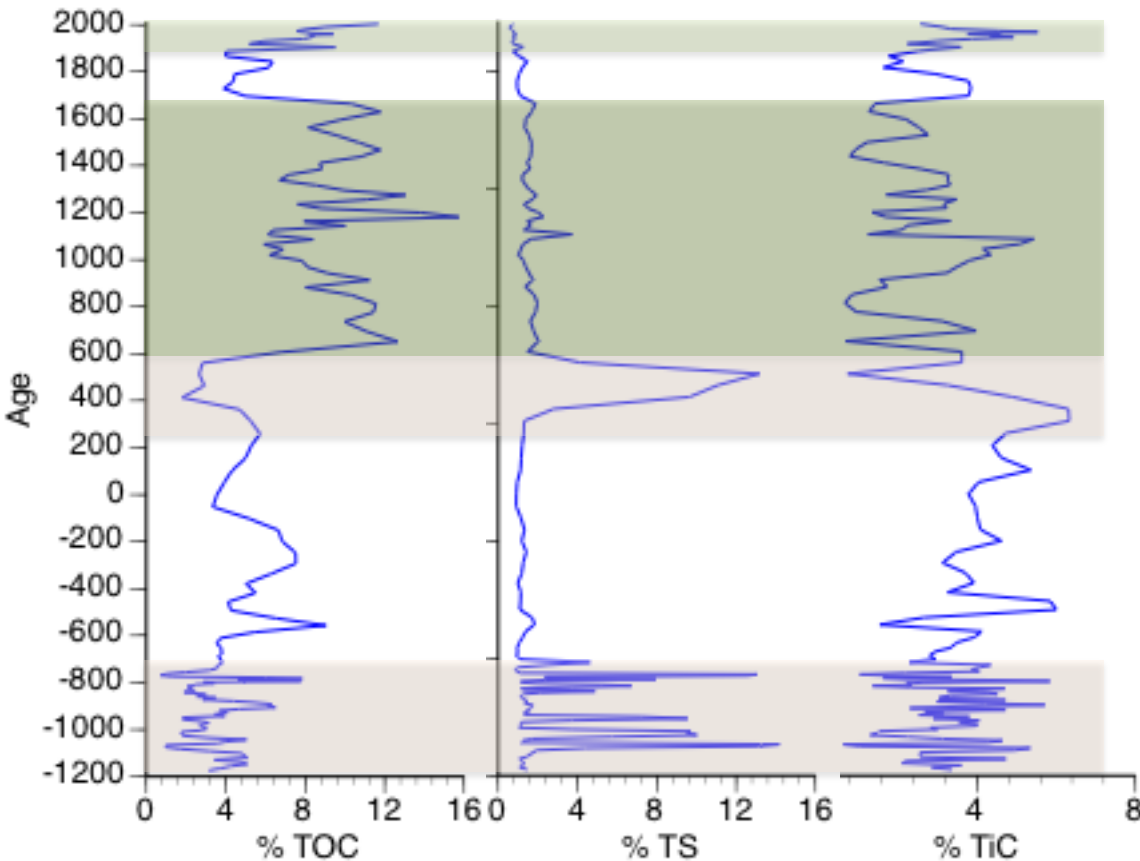
Productivity increase
in two steps

High-energy,
littoral up to
ca. 0.7 ka BP

Higher lake level and
productivity
(ca 3.4- 2.6 ka BP)

Arid prior to ca 3.4 ka BP

Miscanti

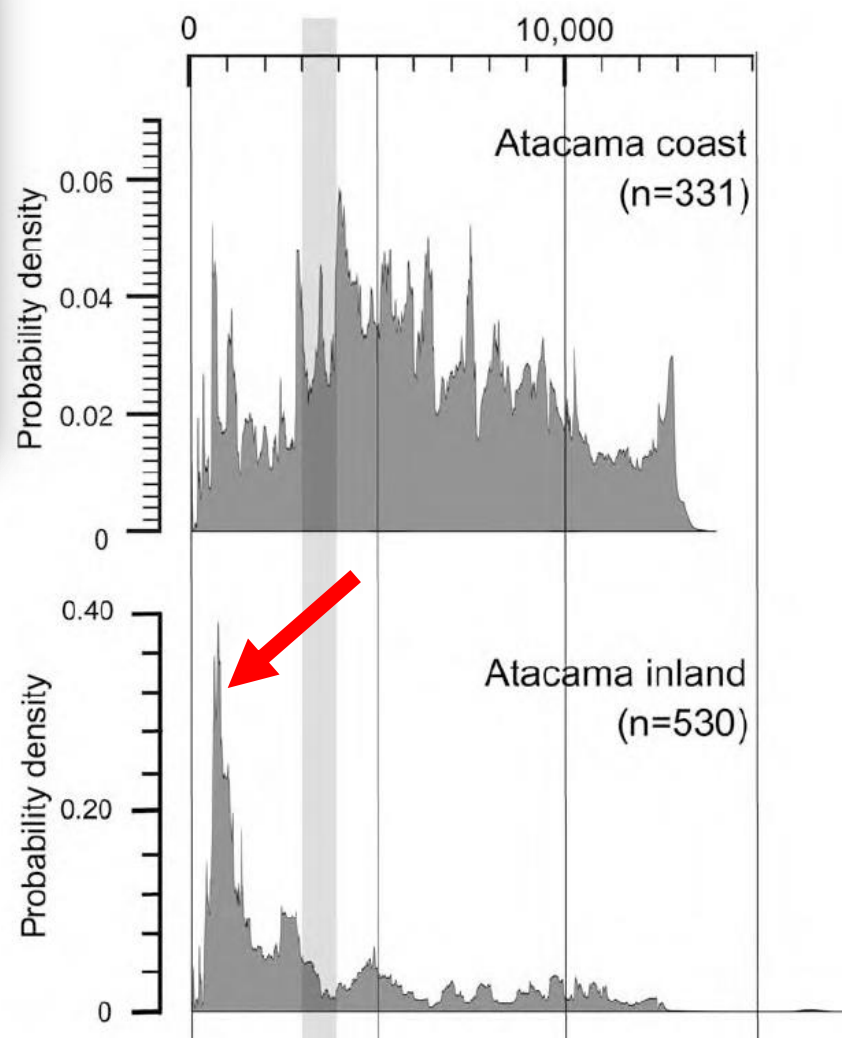


- The highest productivity occurred prior to **1600 - 600 CE** ka BP suggesting relatively higher lake levels
- Lower productivity during the LIA
- Increase in the last century
- More arid prior to 600 CE, particularly between 600 – 200 CE and before 2.7 BP

Paleohydrology

- In spite of dating uncertainties, both lakes show similar patterns during the last centuries: relatively more humid conditions prior to the onset of the Little Ice Age (LIA), a complex LIA (first drier and then more humid) and significant changes associated to the demise of the LIA at the late 19th- early 20th centuries.
- A **humid phase** is coherent with rodent middens and geomorphological features indicative of a major pluvial/recharge event in lower altitudes (Atacama Desert) during the Medieval Climate Anomaly (*ca* 1250 – 650 cal yr BP).

Expansion of “hydraulic societies” in the Atacama



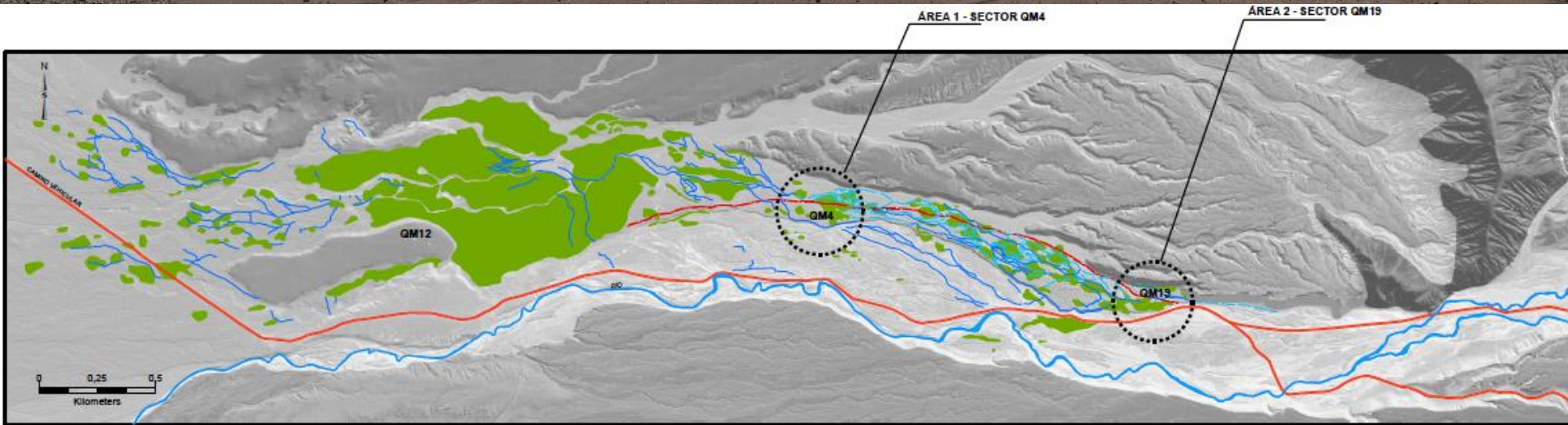
Alan Williams², Calogero M. Santoro³, Michael A. Smith⁴, and Claudio Latorre⁵

Abandonment



Abandoned irrigated cropland in the hyperarid Atacama

Crop fields (AD 900-1300)



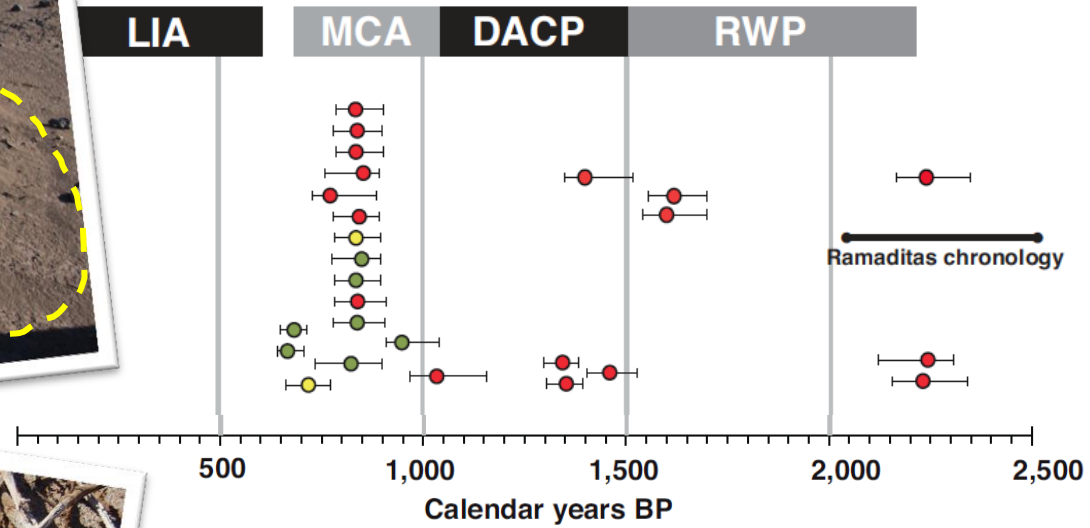
Simbología

- Área Cultivo Arqueológica Registrada
- Cauce actual
- Canal Arq. Visible
- Canal Arq. Proyectado
- Camino en cauce
- Camino sobre terraza

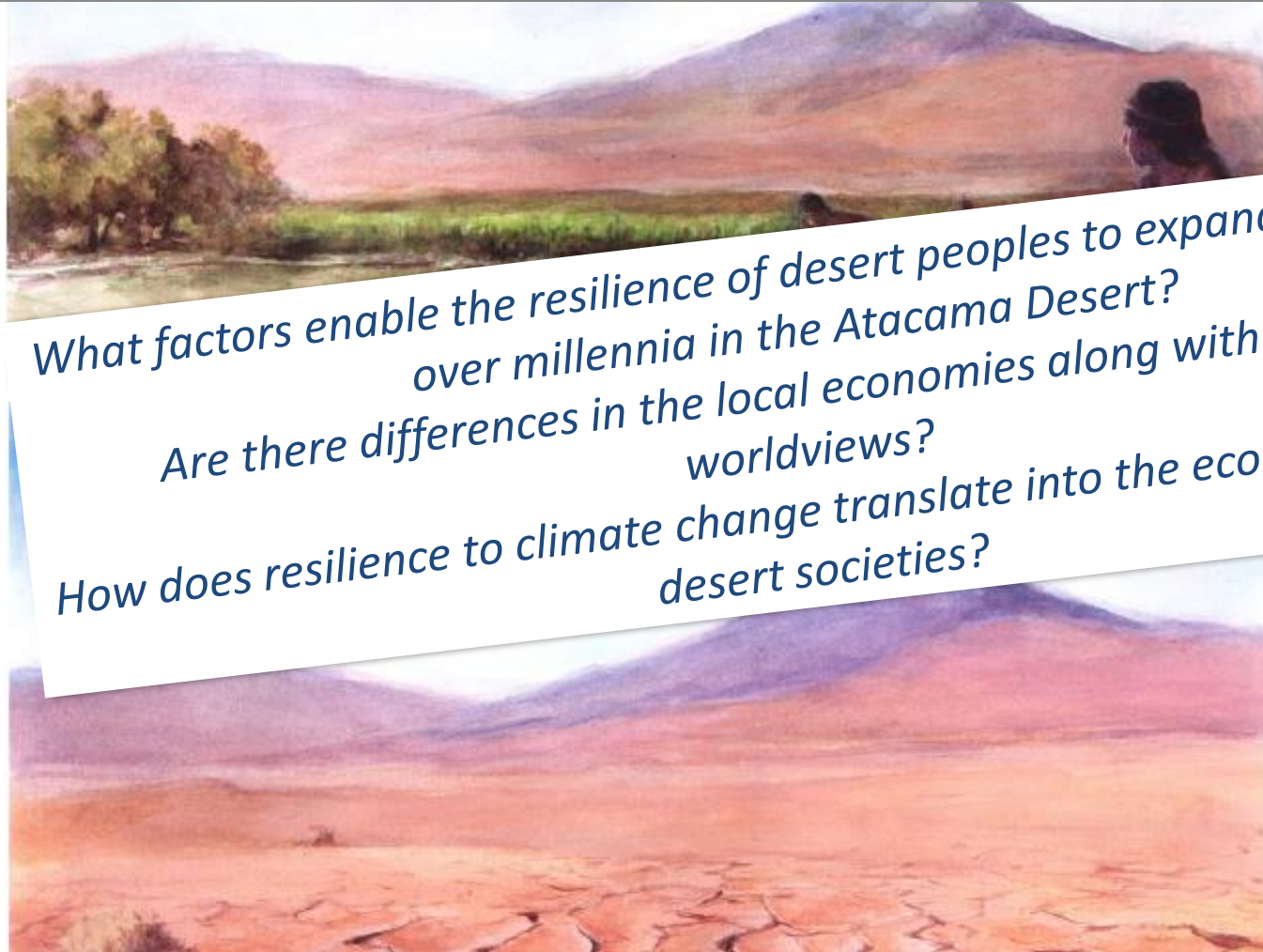
Quebrada Maní

Santoro, Latorre, Rozas et al., en prep.

A humid MCA



Conclusions



*What factors enable the resilience of desert peoples to expand and contract over millennia in the Atacama Desert?
Are there differences in the local economies along with different worldviews?
How does resilience to climate change translate into the economies of these desert societies?*

REINA DEL TAMARUGAL

La Niña y el poblamiento humano del desierto de Atacama

www.6sentidos.cl

Thanks



MINECO, Spanish Ministry of Economy and Competiveness
Pontificia Universidad Católica
Laboratorio Internacional de Cambio Global
Participants in HoloChill2013 Expedition



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