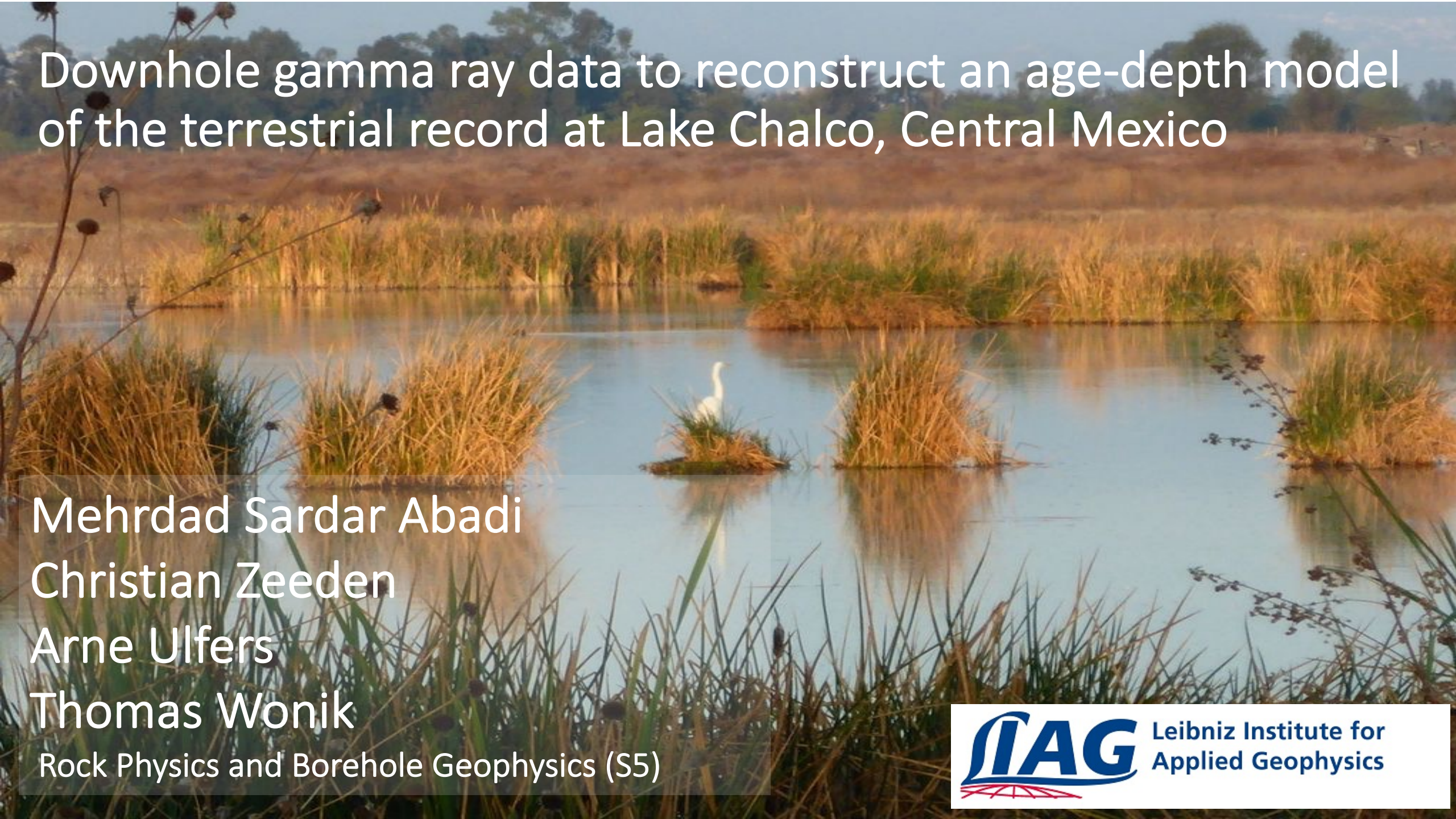
Downhole gamma ray data to reconstruct an age-depth model of the terrestrial record at Lake Chalco, Central Mexico



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Rock Physics and Borehole Geophysics (S5)

Leibniz Institute for Applied Geophysics

MEXIDRILL: The Basin of Mexico Drilling Program — ICDP project

- Central Mexico consisted of several extensive lake systems
- Primary civilization c.a. 12,000 years ago
  Aztec city: Tenochtitlan
- Spanish drained the lake system in the 1600s
- ICDP Mexidrill project started in 2016
- LIAG conducted geophysical downhole logging

The Valley of Mexico at the time of the Spanish conquest, c. 1519

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Origin of γ Ray Signal

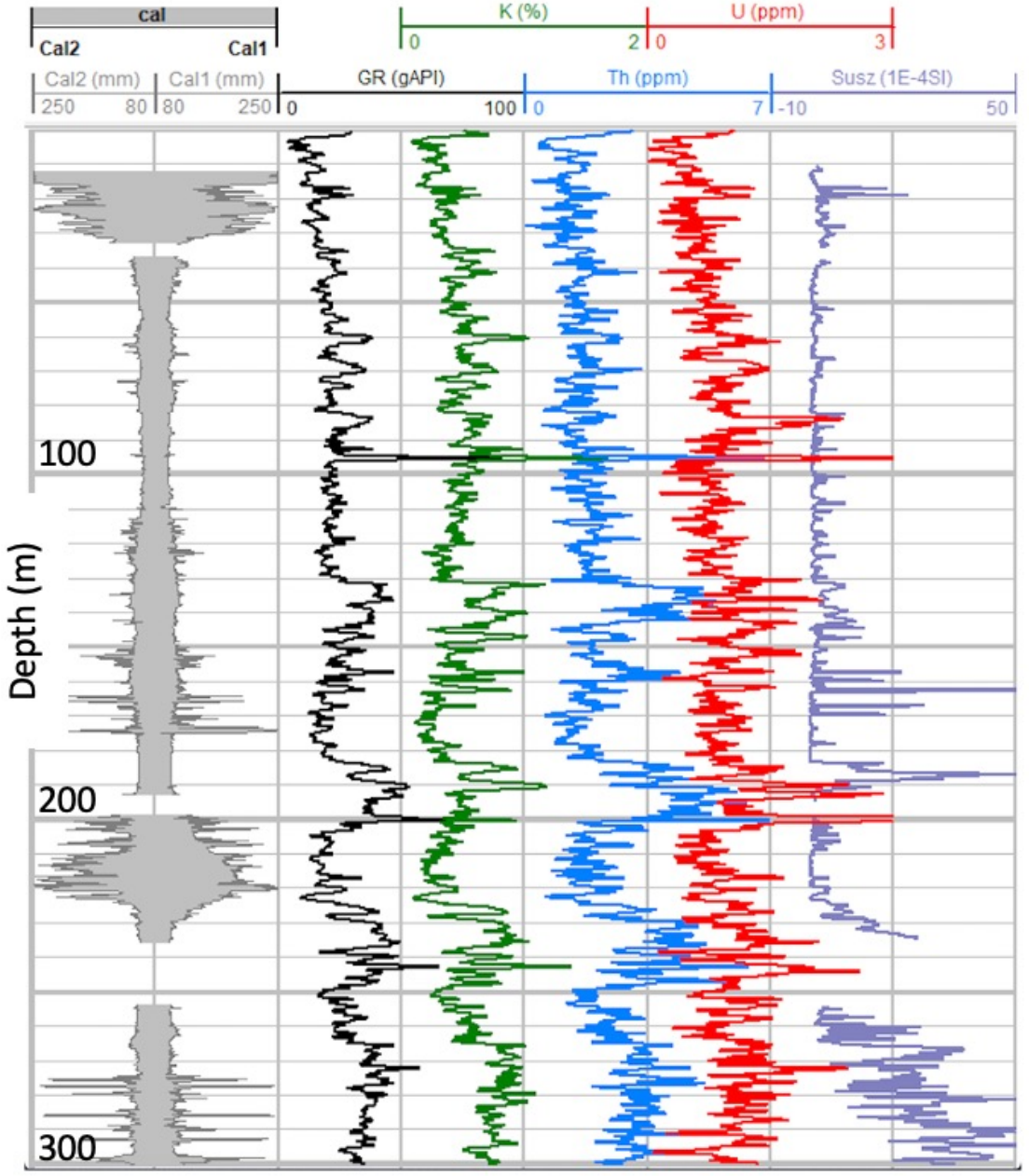
Strong covariance between γ ray and Magnetic susceptibility!

Sediments transported from altered volcanogenic rocks are the main source of γ Ray radiation!

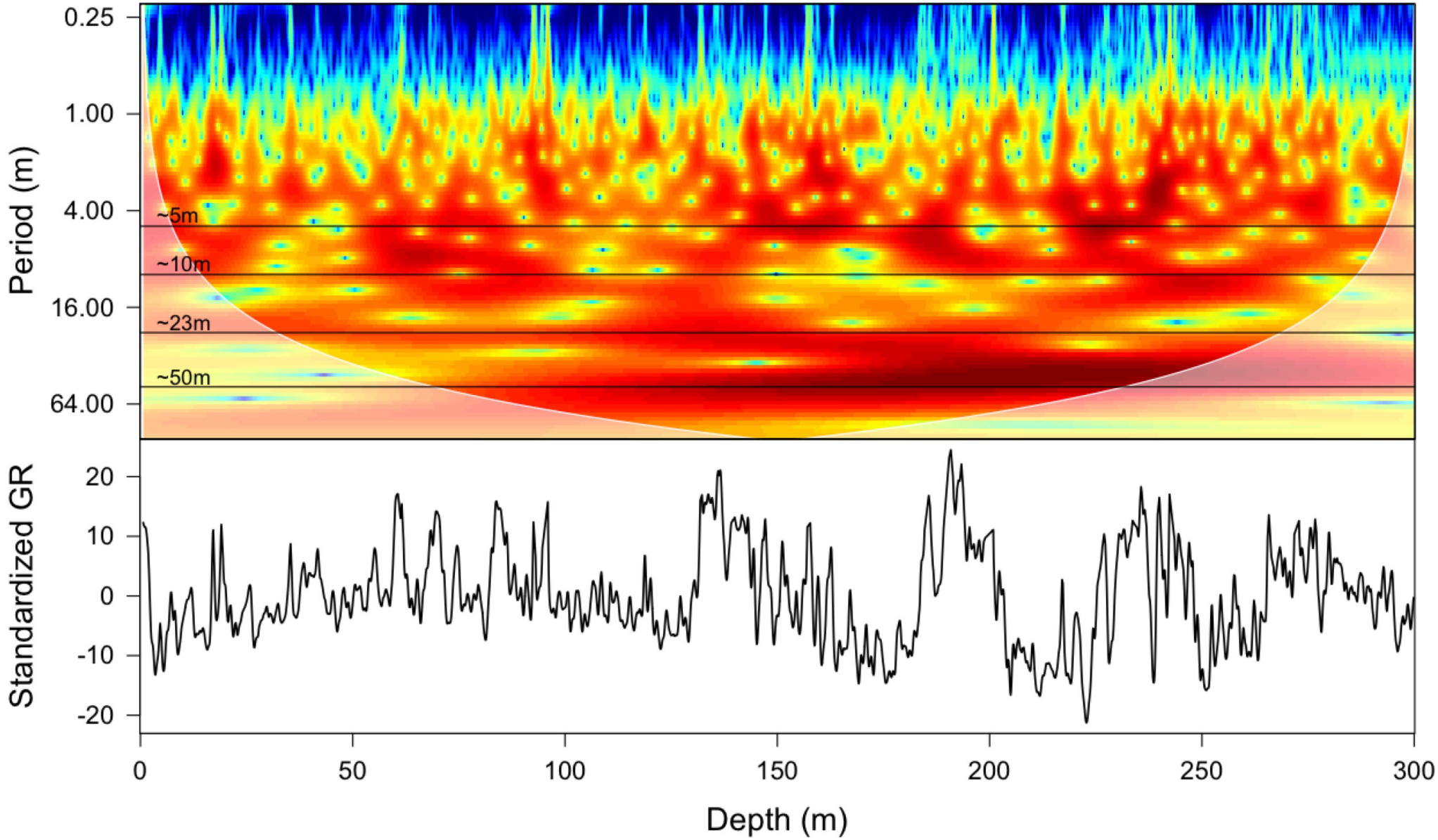
Silicate-weathering rate in source

detrital input ↑ → GR ↑

detrital input ↓ → GR ↓



Cyclicity



Existence of regular cyclicity in γ Ray log!

TimeOpt!

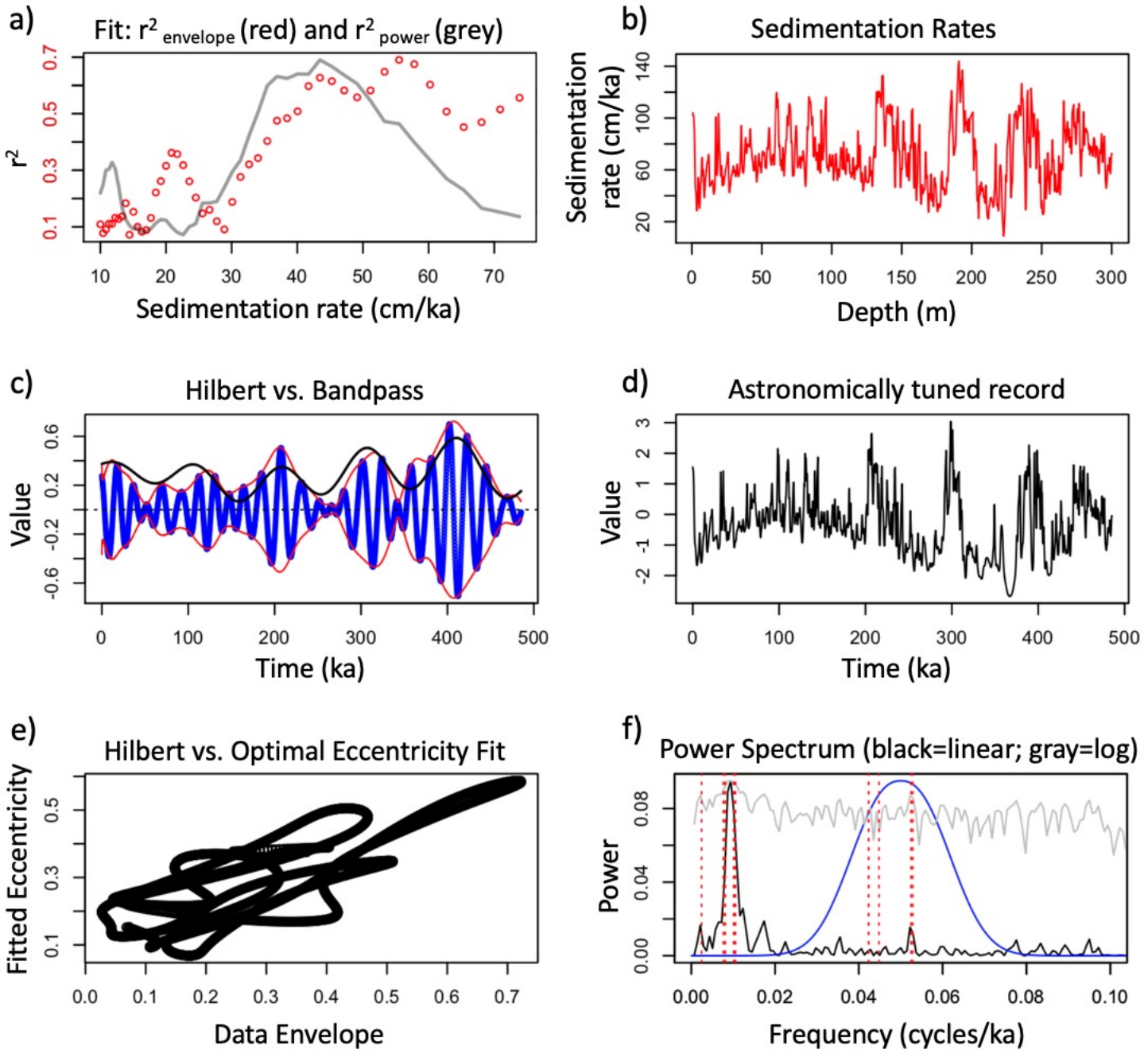
(Meyers, 2015)

Initial average sedimentation rate = 43.5 cm/ka

We used the increased ramp template

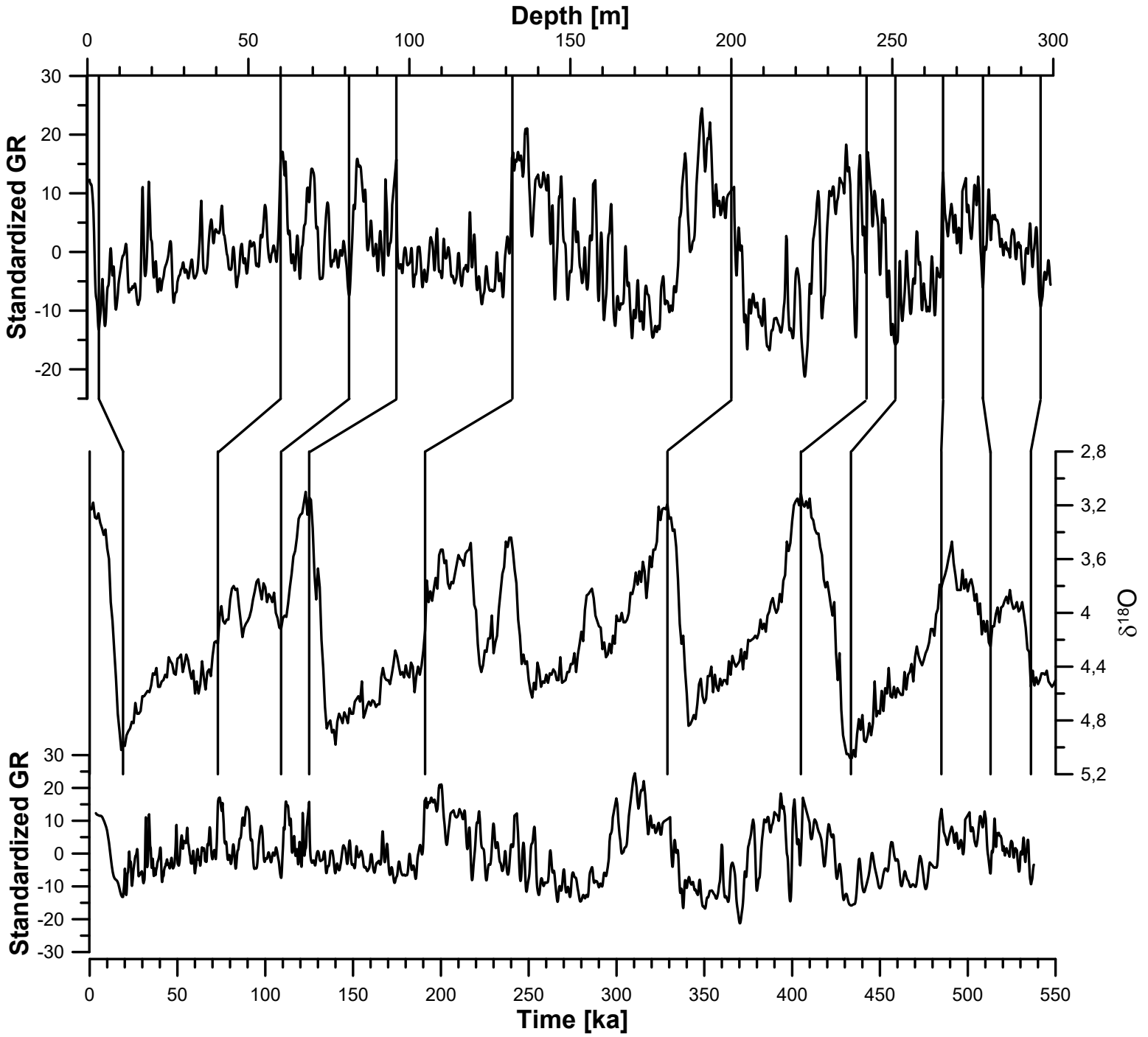
higher detrital values

= higher γ Ray



Correlation to LR04!

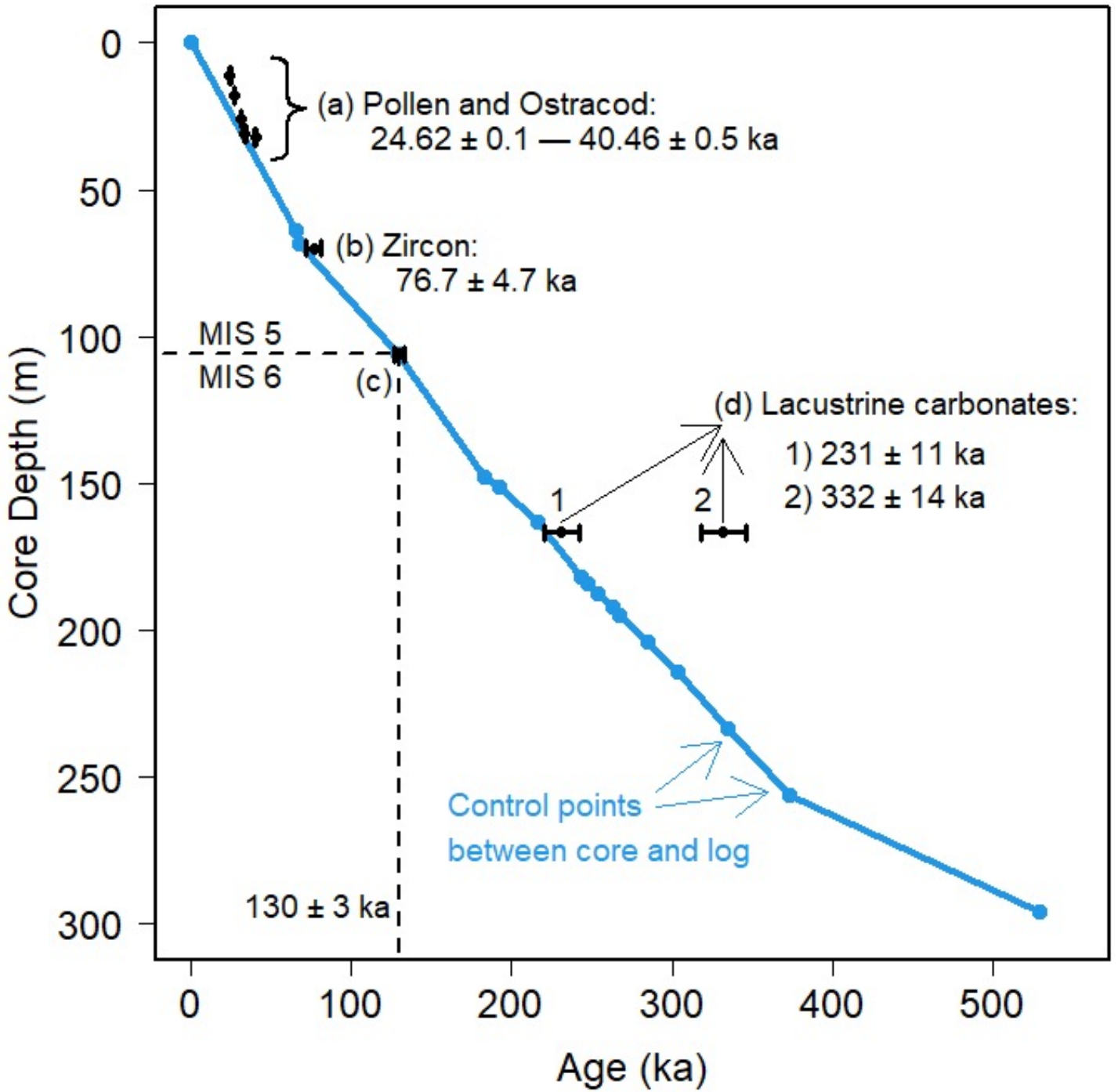
The duration of lacustrine deposits extended to over a period of 500 ka!



Age-depth model

Orbitally tuned timeframe calibrated with previous available radioisotope ages

A consistent astronomical tuned time scale!



Uncertainty of Astronomical Age Model

Three factors cause uncertainties:

1. Imprecision of tie points
2. Intrinsic uncertainty in LR04 stack
3. Feedbacks to glacial-interglacial cycles

10 ka uncertainties at/or around tie points,
Uncertainties increase up to 20 ka with increasing distance from tie points!

Thank you

Thomas Grelle
Carlos Lehne
Jan-Thorsten Blake

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Source of GR in lacustrine sediments

- Silicate-weathering rate in source

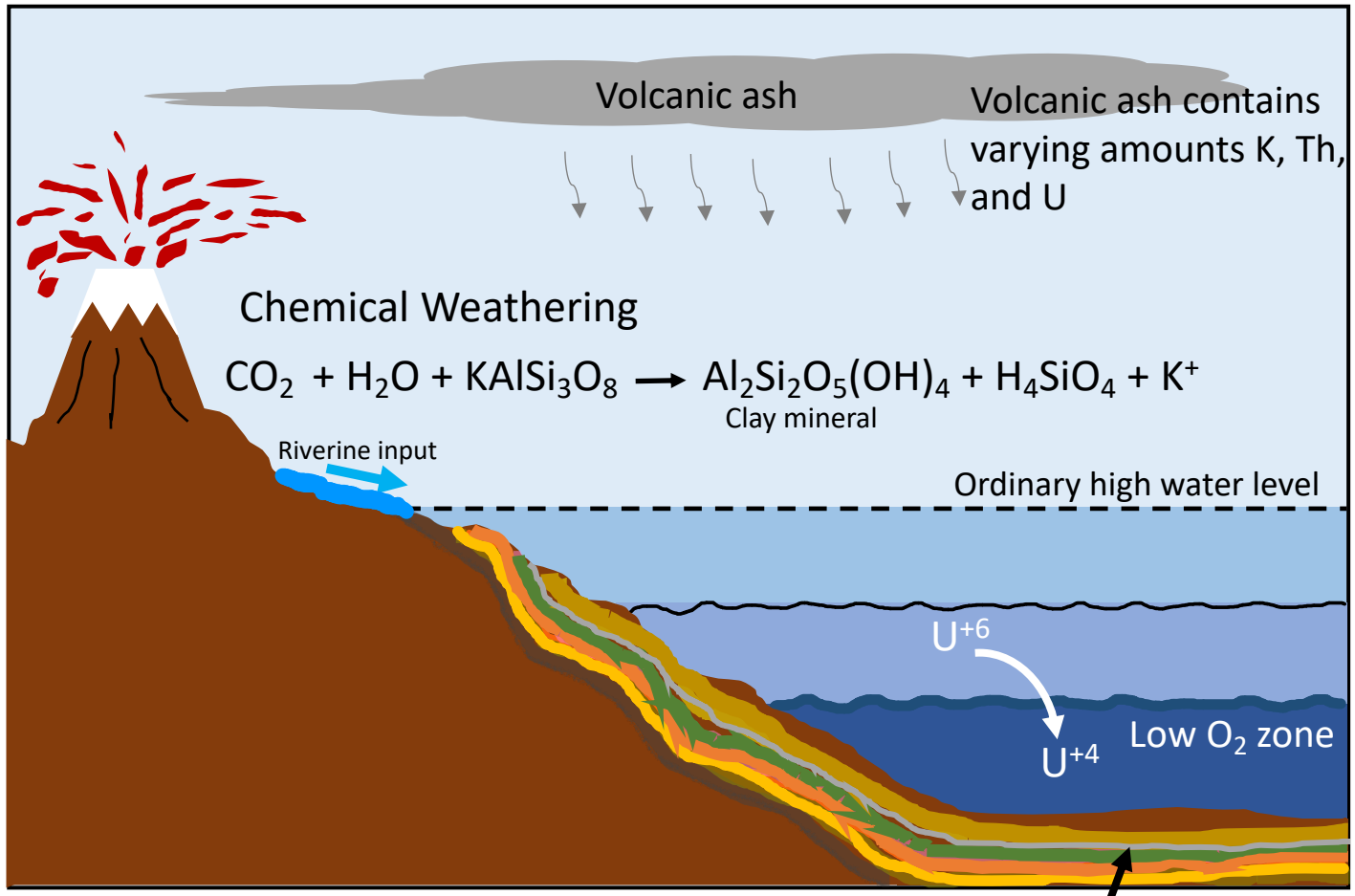
  detrital input ↑ → GR ↑

  detrital input ↓ → GR ↓

- Tephra layer → GR↑

- Redox condition in bottom water → U^{+4} → GR↑

- Salinity enhance concentration of K and Th ions



lake sediments contain **tephra layers**

Tephra is comprised of unconsolidated pyroclastic particles of magma caused by volcanic eruptions