

Asian paleoenvironment, paleogeography and paleobiodiversity interactions during the Greenhouse-Icehouse transition



www.paleoenvironment.eu



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Magic meeting 2019



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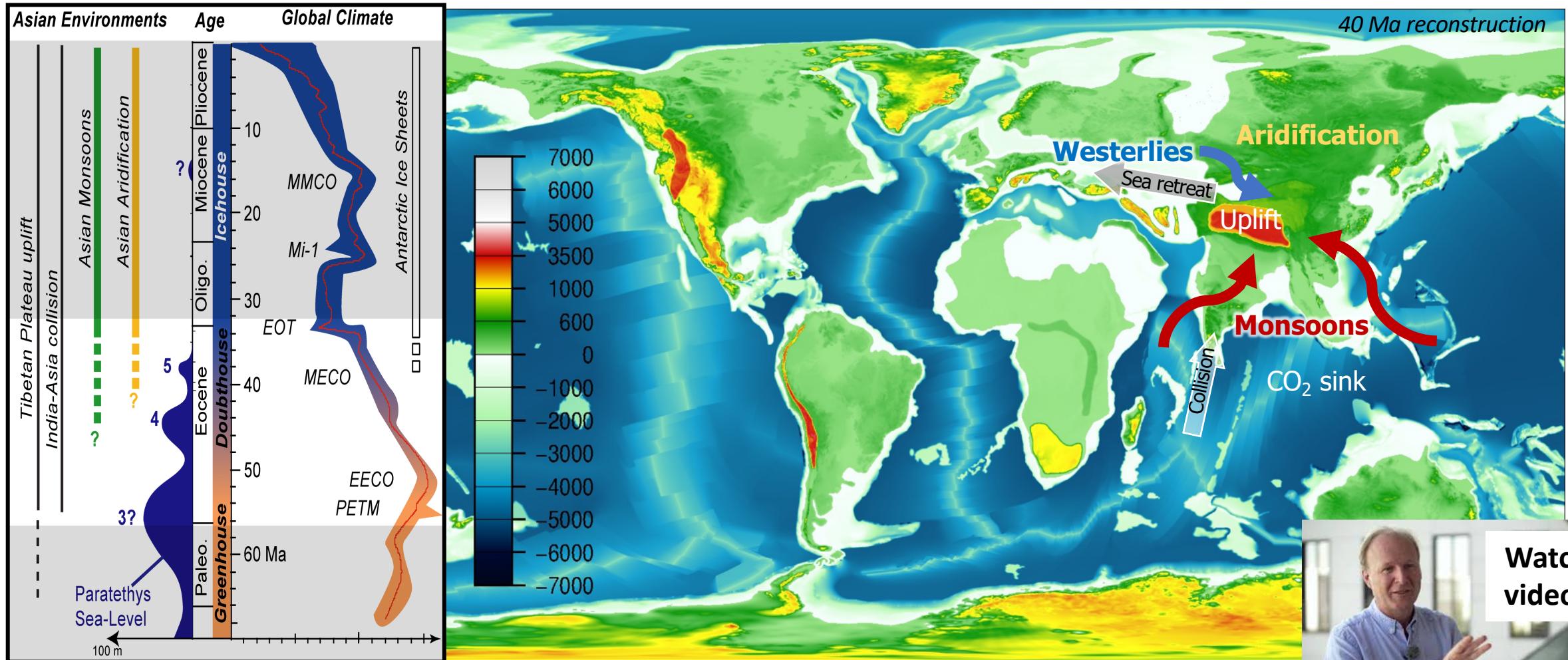
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⁹ Centre Européen Recherche Enseignement Géosciences Environnement (CEREGE), Aix en Provence, France



Asian Climate and Tectonic and tectonic context



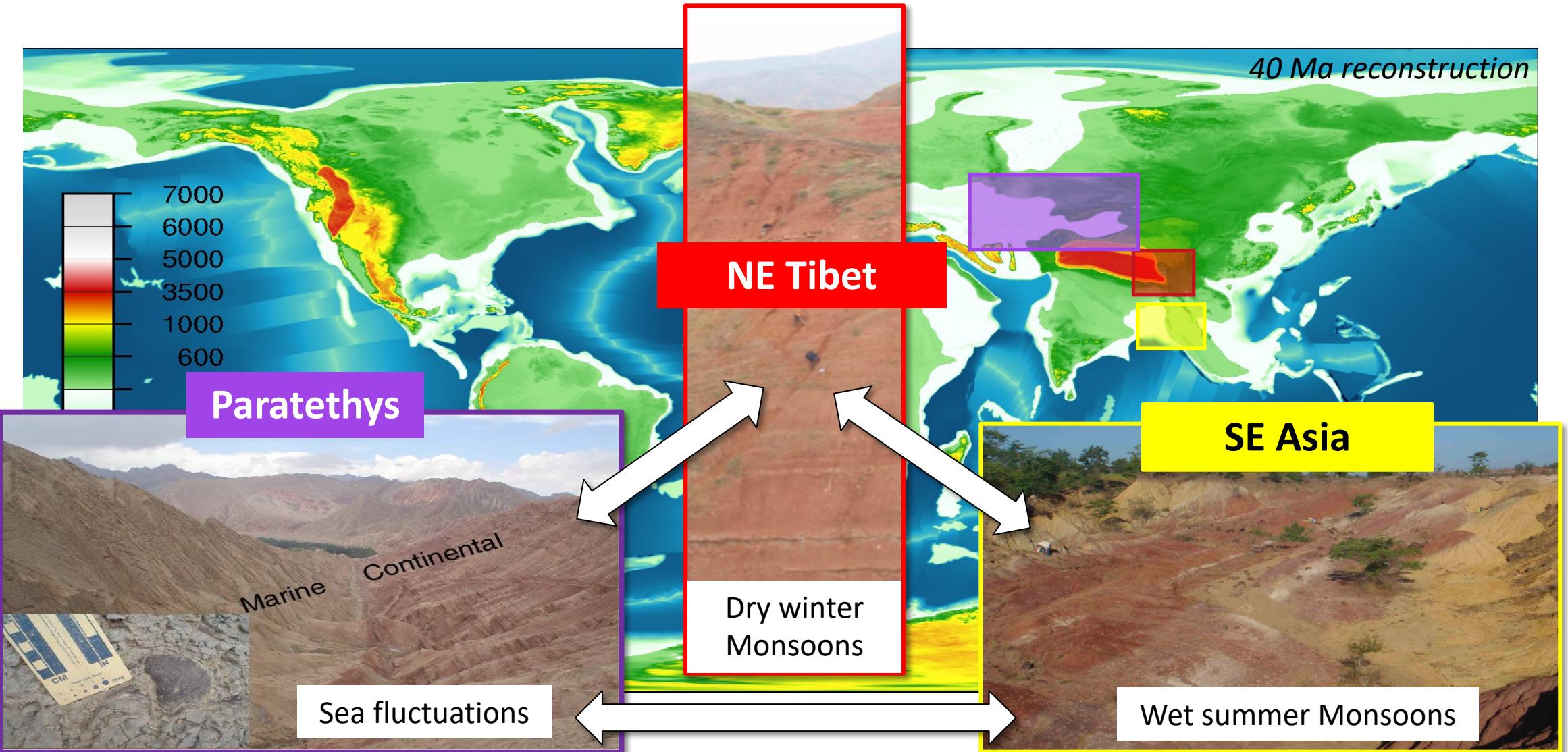
MAGIC MONSOONS IN ASIA CAUSED GREENHOUSE TO ICEHOUSE COOLING?

Project website: www.paleoenvironment.eu/magic



What is MAGIC?
Scientific goals

3 key sedimentary records



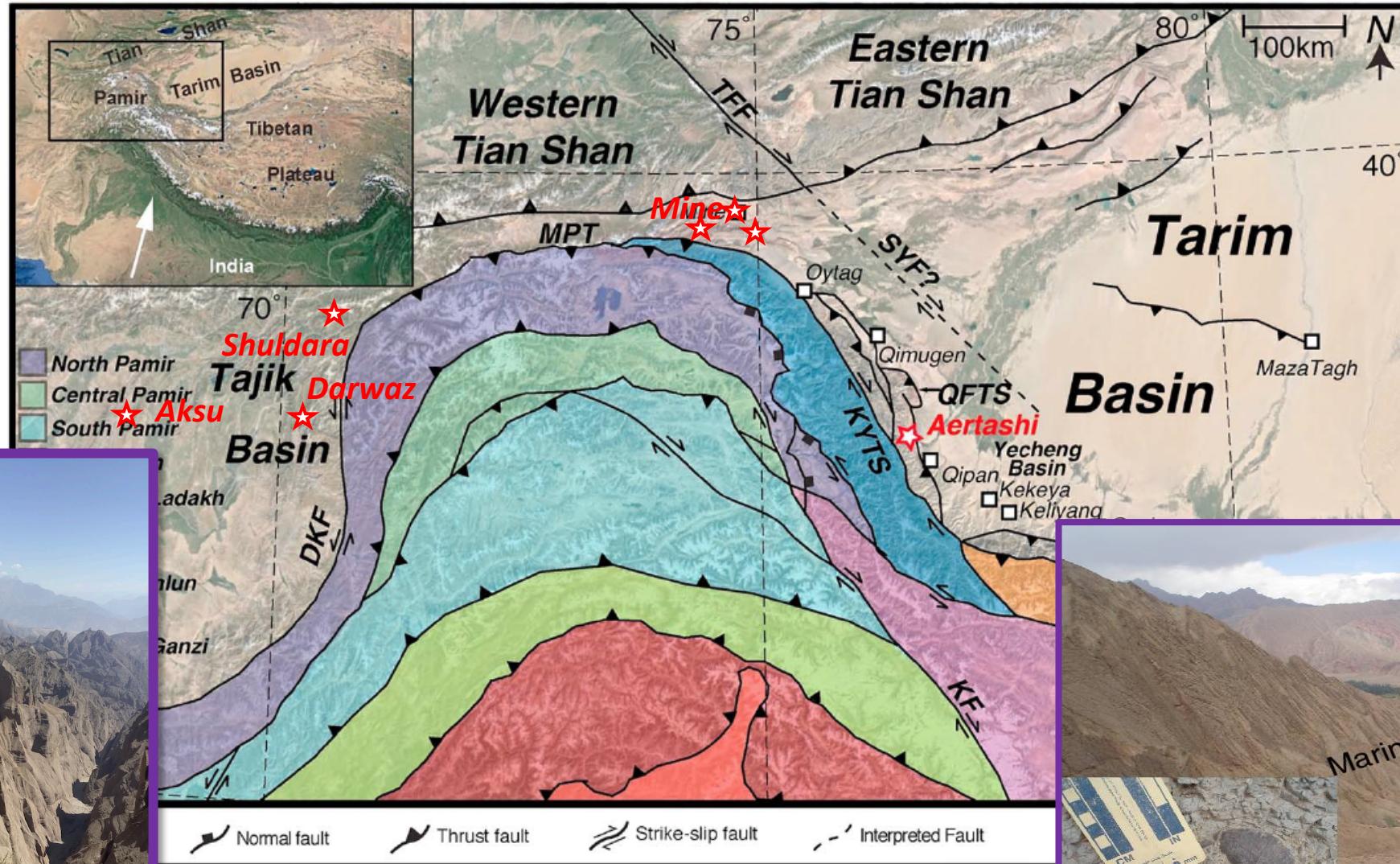
MAGIC MONSOONS IN ASIA CAUSED GREENHOUSE TO ICEHOUSE COOLING?





Lin Li

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Yani Najman

Jean-Noël Proust



Mustafa
Kaya

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Watch Mustafa's
video





Lin Li

Find out
Lin's new
discoveries:

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Did Pamir uplift change Asian climate? When and how did Pamir grow?

- Asian aridification due to westerly moisture shielded by Pamir growth ?
- Asian Aridification due to sea retreat in response to Pamir growth?
- Monsoons increase due to sea retreat enhancing land-sea contrast?

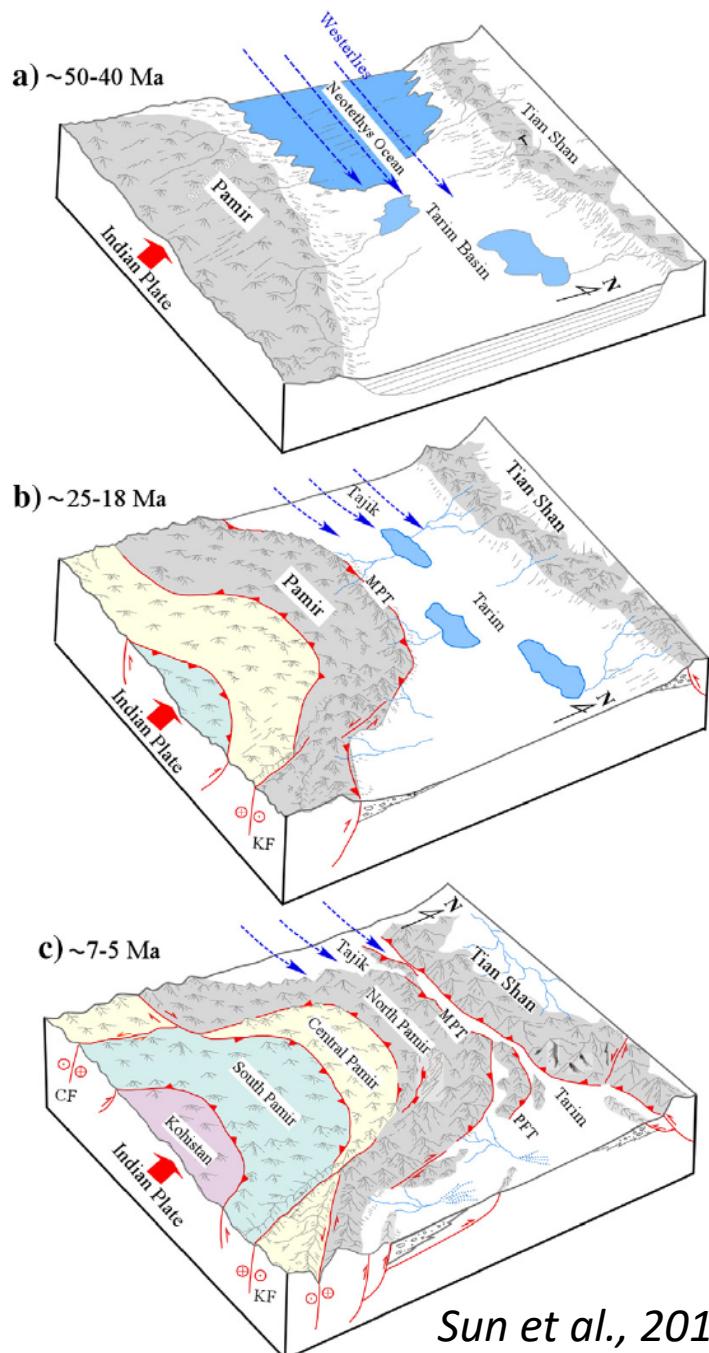
Asian Aridification Age?

East of the Pamir in the Tarim Basin

- 5.3 Ma (*Sun et al., 2017*)
- 41 and 15-10 Ma (*Bougeois et al., 2018*)
- 26 Ma (*Zheng et al., 2015*)

West of the Pamir In the Tajik Basin

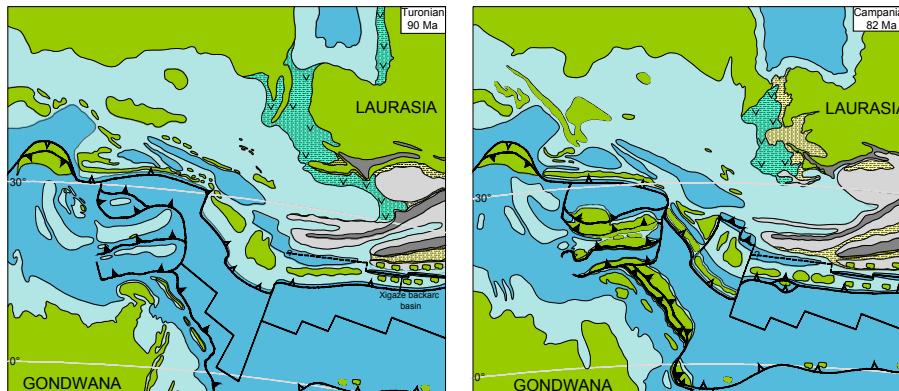
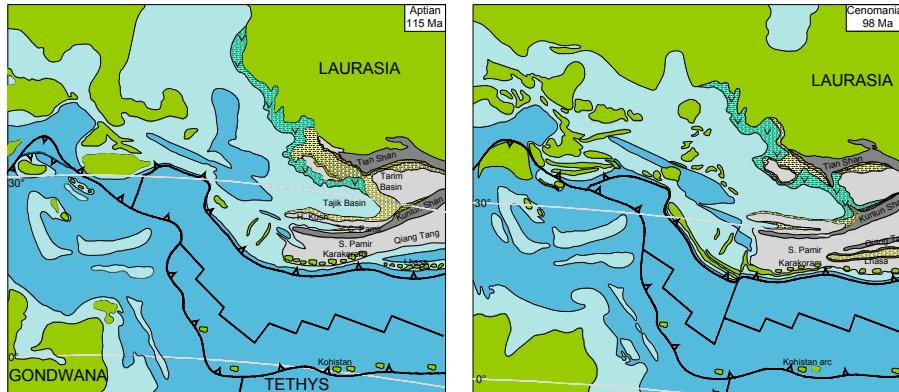
- 10-6 Ma (*Lü et al., 2020*)
- 10-5 Ma (*Caves et al., 2017*)
- 25 Ma (*Wang et al., 2020*)
- 37 Ma (*Bosboom et al., 2014, 17; Carappa et al., 2015; Kaya et al., 2019*)





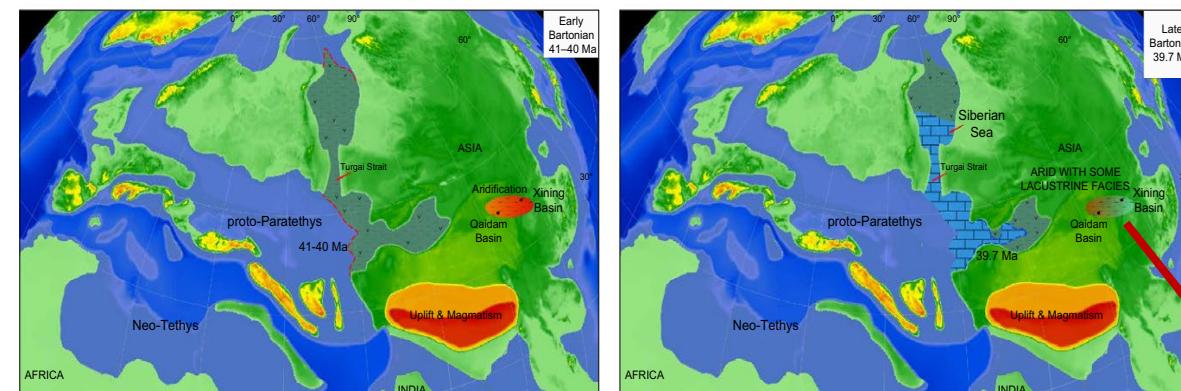
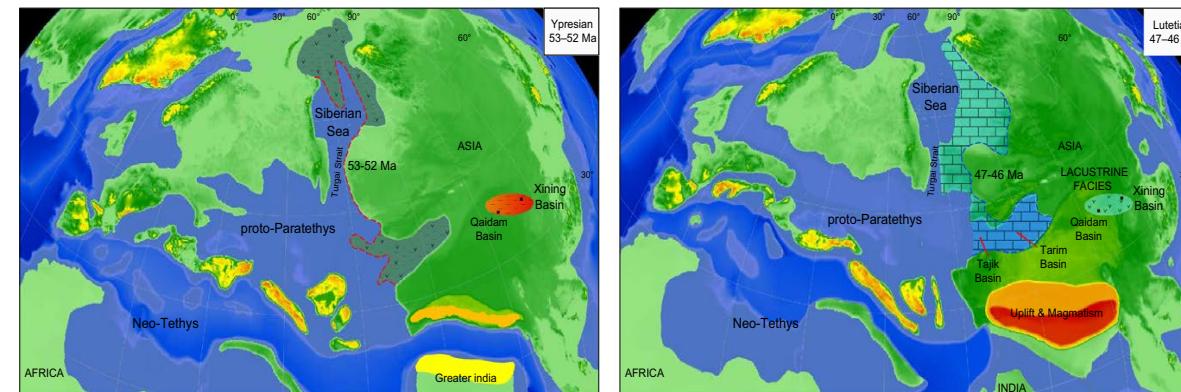
Proto-Paratethys sea from birth to death

Cretaceous
Kaya et al., Tectonics in revision



- 115 Ma birth in retro-arc basin linked to collision and subduction.
- 90 sharp subsidence slowdown related to roll back.
- Maastrichtian global cooling event.

Paleogene
Kaya et al., Basin Research, 2019



- Three major sea incursions reconstructed.
- 40 Ma onset of fast subsidence driven by tectonism.
- Sea fluctuations modulate Asian interior moisture.



**Mustafa
Kaya**

Find out
Mustafa's
new PETM
discovery:

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**Effect on Asian
climate
records?**

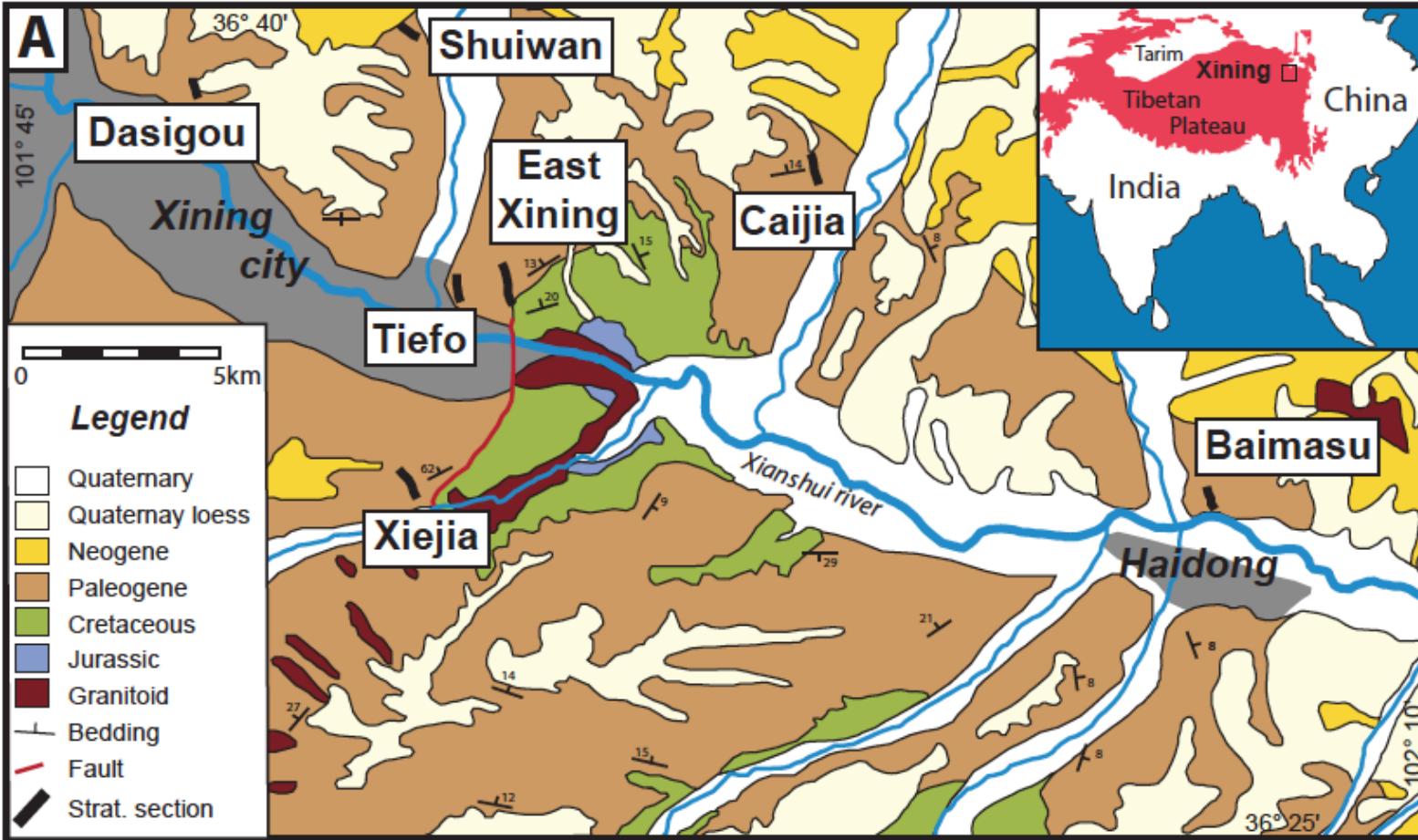
NE Tibet Climate record

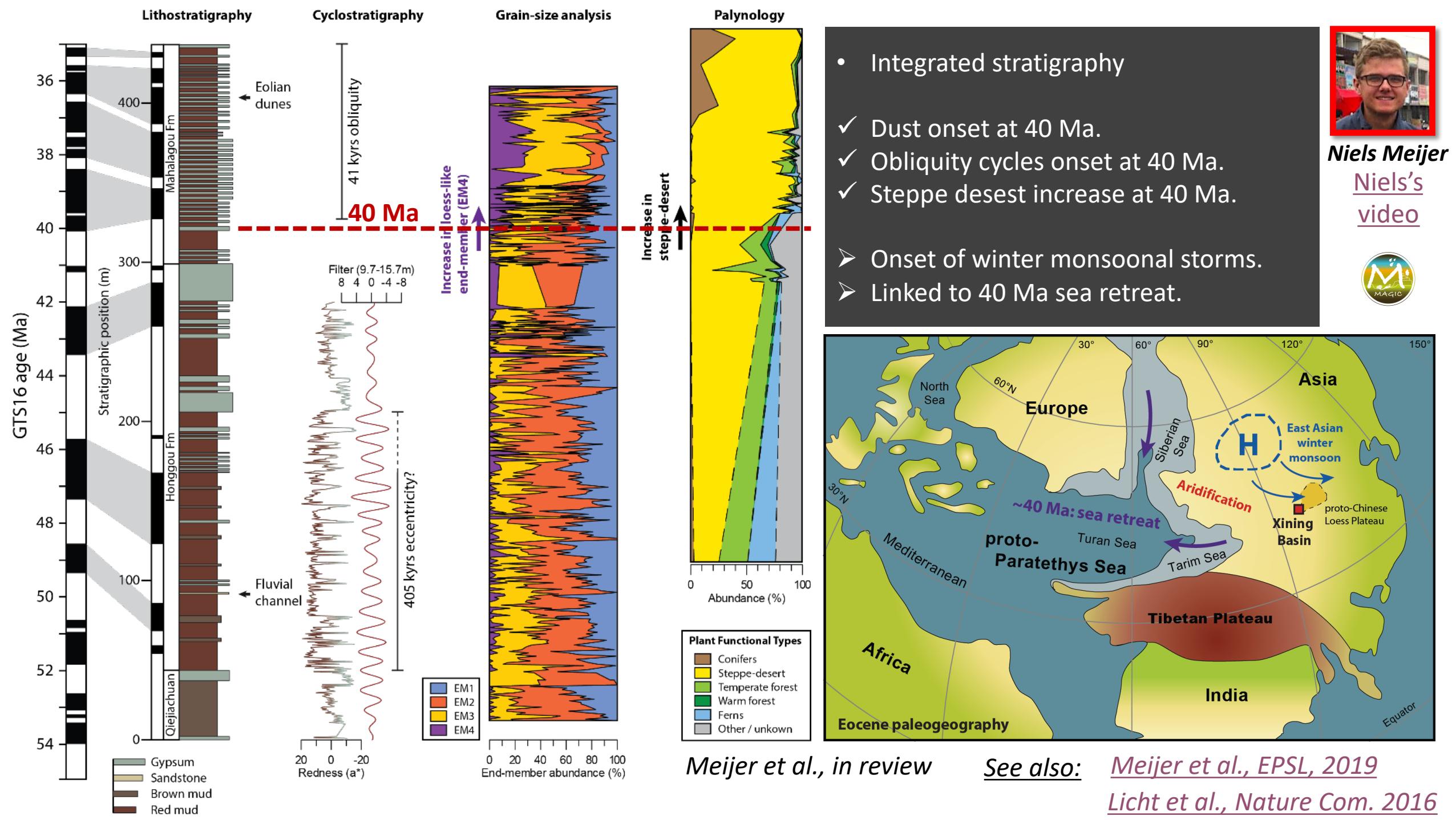


Niels Meijer

Xining Basin

[Niels's video](#)







SE Asia tectonic reconstruction

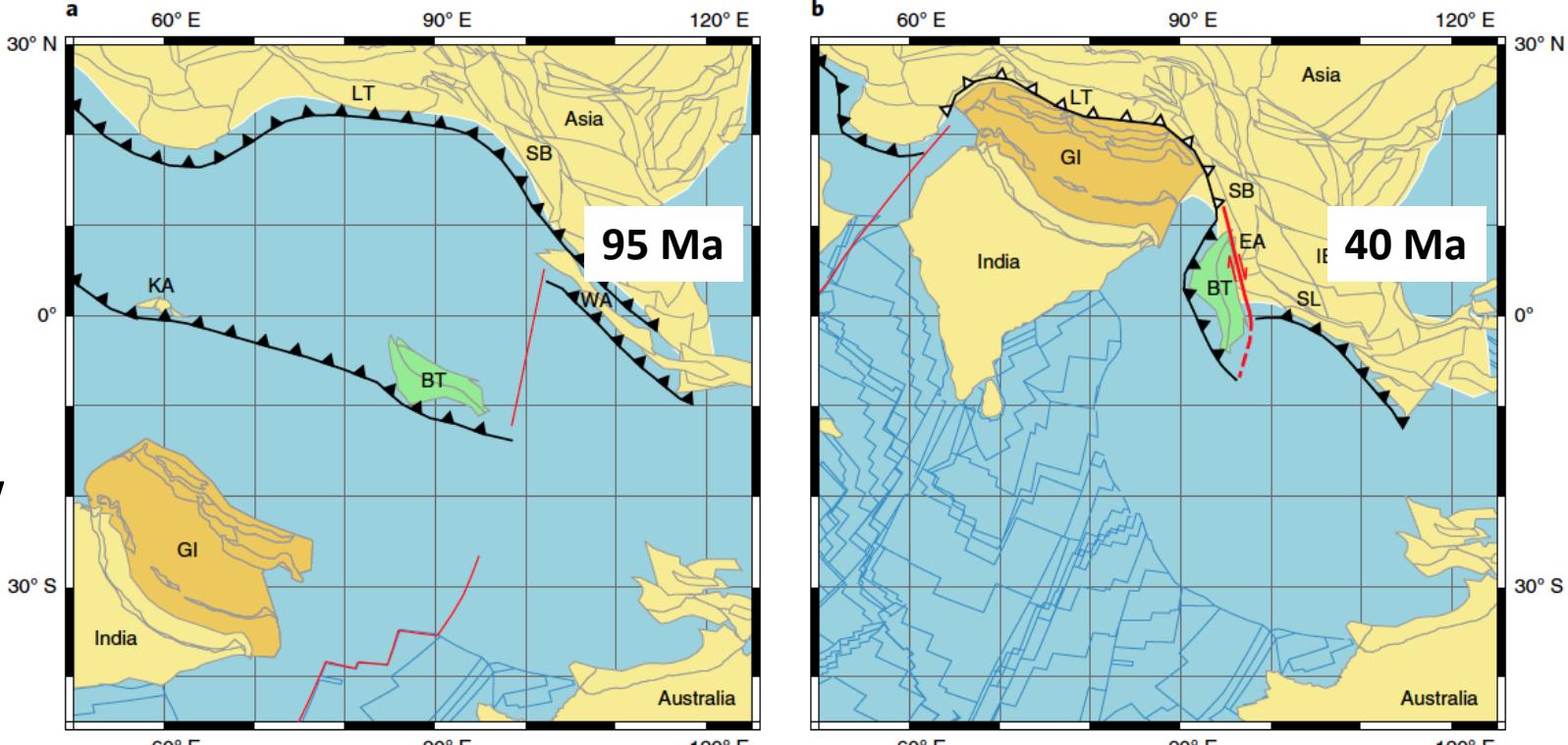


Jan
Westerweel

Find out Jan's new
discoveries:

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[Westerweel et al., Nature Geosciences 2019](#)

Co-supervision: Pierrick Roperch



and Alexis Licht



[See also:](#)

[Licht et al., 2019](#)

- Paleomagnetism indicate northward transport and rotation of the Burma plate.
- Burma Plate low paleolatitudes support Trans-Tethyan collision model.
- Island endemism for the Burmese amber biota.



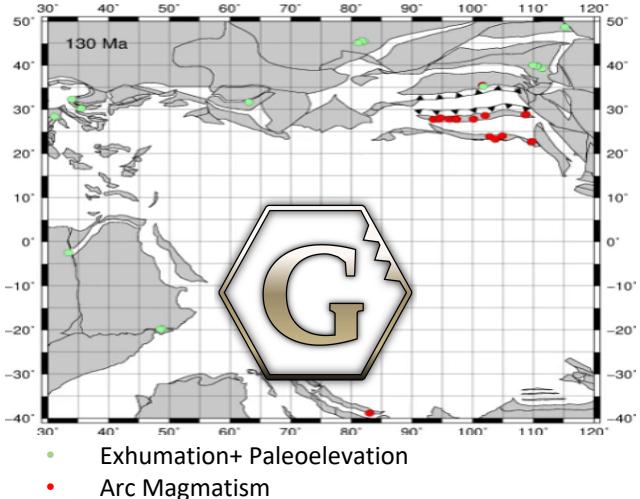
Fernando
Poblete



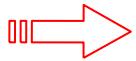
Paleogeographic Reconstructions

Reconstructions

At 60, 50, 40, 30, 20 Ma



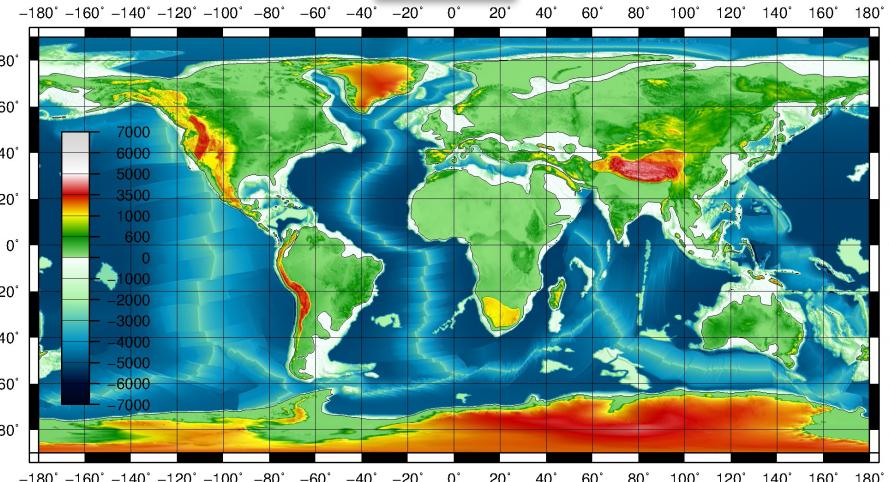
- ✓ New plate tectonic model.
- ✓ Global compilation: literature review, facies, radiochronologic, fossil, tectonic context, etc..
- ✓ PaleoDEM through the Cenozoic.
- For climate model simulations.



Diego
Ruiz



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Website

<https://map.paleoenvironment.eu>

Thomas
van der Linden



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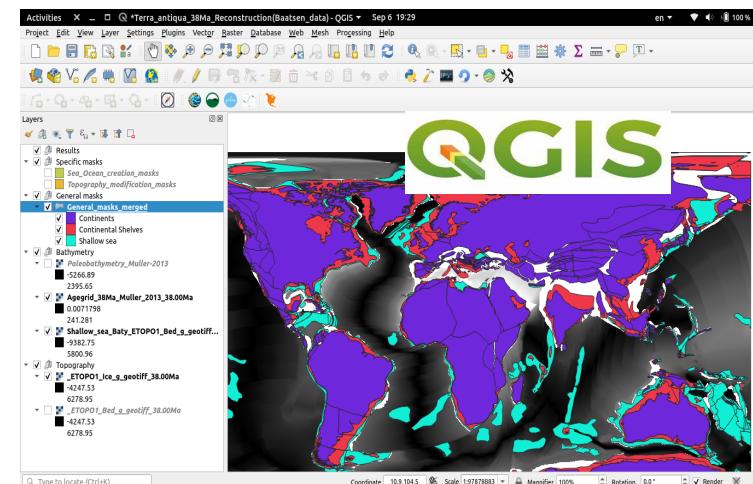
Co-supervision: Douwe van Hinsbergen



Jovid
Aminov

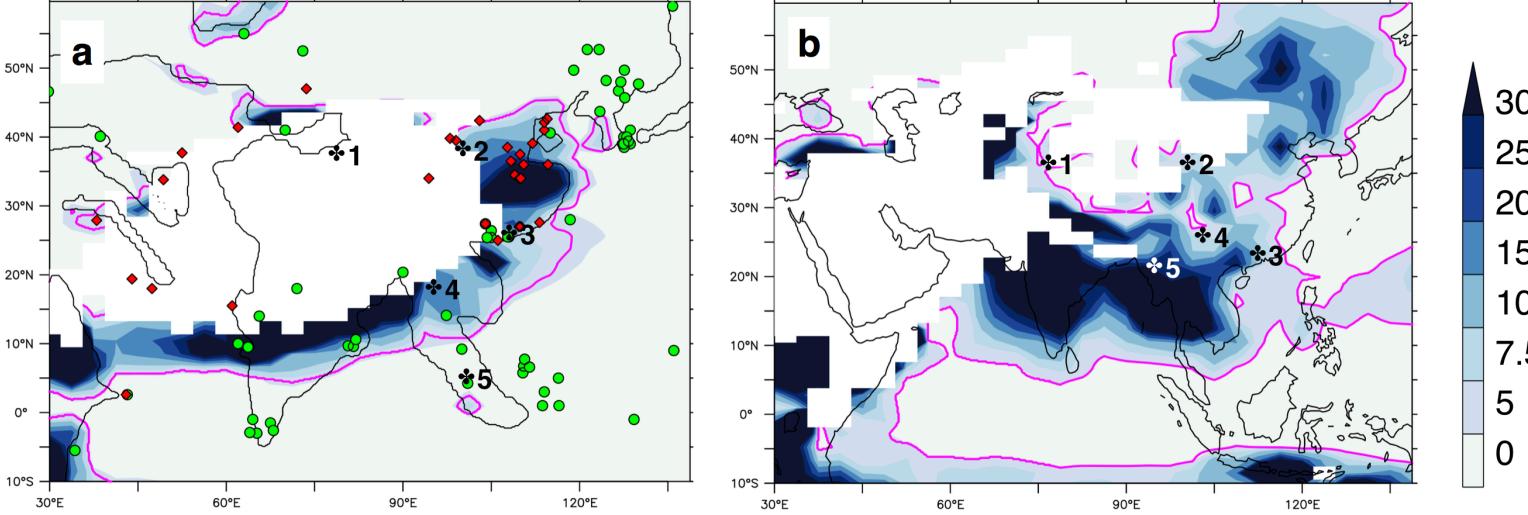


Terra Antiqua
QGIS plugin



- Graphical user interface.
- Generate quickly multiple reconstructions.
- User-friendly data management and treatment
- high degree of flexibility of the reconstruction steps.
- digital elevation model (DEM) exported in any GIS-format.

Climate model simulations



3 Wet/ 3 Dry months ratio (3W/3D) for Eocene paleogeography and 4X preindustrial CO₂ (a) and Control simulation (b). Regions receiving less than 1mm/day are kept blank. Overlaid purple outline corresponds to the value 3W3D=5 considered as minimum value in modern monsoonal regions. Data comparison with evaporite (red diamonds) and coal deposits (green circles) from Boucot et al. 2013, as well as the five highlighted regions described in the MAGIC project .

Co-supervision: Fred Fluteau



Yannick Donnadieu



*Delphine
Tardif*
[Delphine's
video](#)



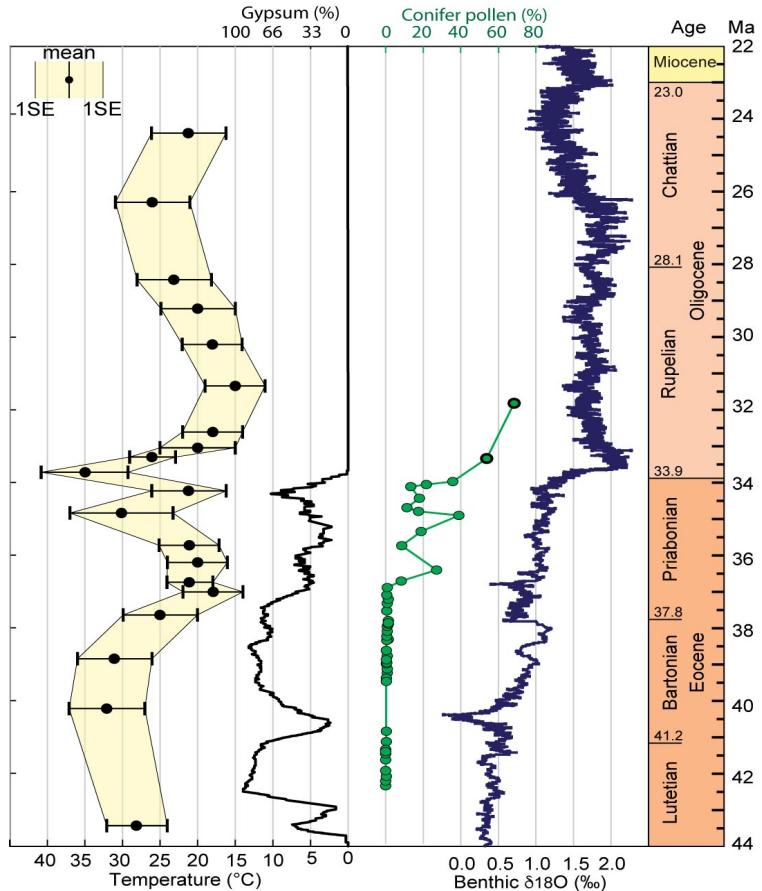
*Agathe
Toumoulin*
[Agathe's
video](#)

- IPSL-CM5A2 earth system model and revised paleogeographies.
 - ✓ A broad arid region located over Himalaya and Tibet.
 - ✓ More humid seasons encircle this arid area due to ITCZ and I-AM rather than monsoons.
- Arid climate prevailed before the onset of Monsoons that most likely occurred following Eocene paleogeographic changes.
- Precipitation seasonality should be used with caution to infer the presence of a monsoonal circulation.

[Tardif et al., Climate of the past, in press](#)
[Toumoulin et al., Paleo2, in revision](#)

Asian climate and biome shift

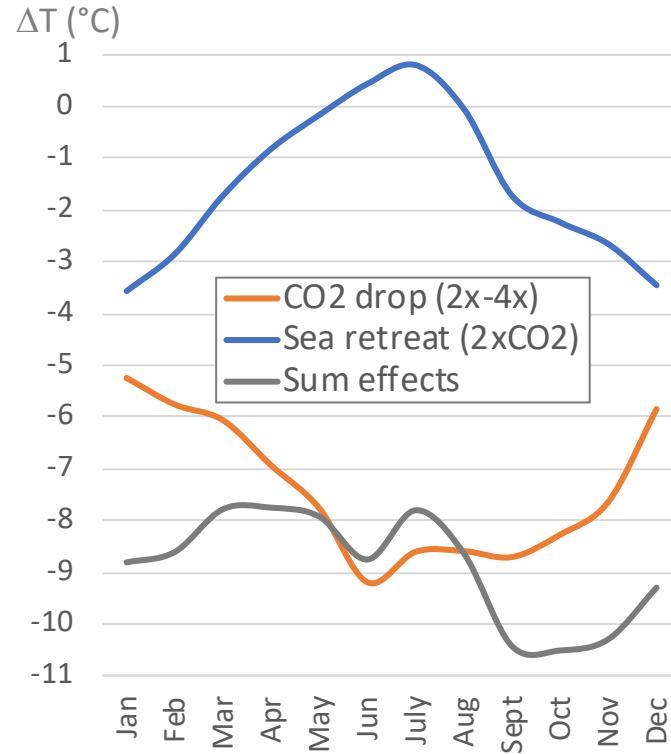
Temperature, aridity and plant records



Co-supervision:
Carina Hoorn

Page et al., Geology 2019
Barbolini et al., in revision

Temperature shifts from climate simulations



Natasha Barbolini
[Natasha's video](#)



Amber Woutersen
[Amber's video](#)



Alexis Licht



Alexander Rohrmann
[Alex's video](#)

- ✓ Asian desert since at least Eocene.
- ✓ Greenhouse –Icehouse vegetation change.
- ✓ Vegetation changes linked to temperature drop, aridification and change in cold / moist seasons.

➤ Major biome shifts at the EOT.

To be compared to:

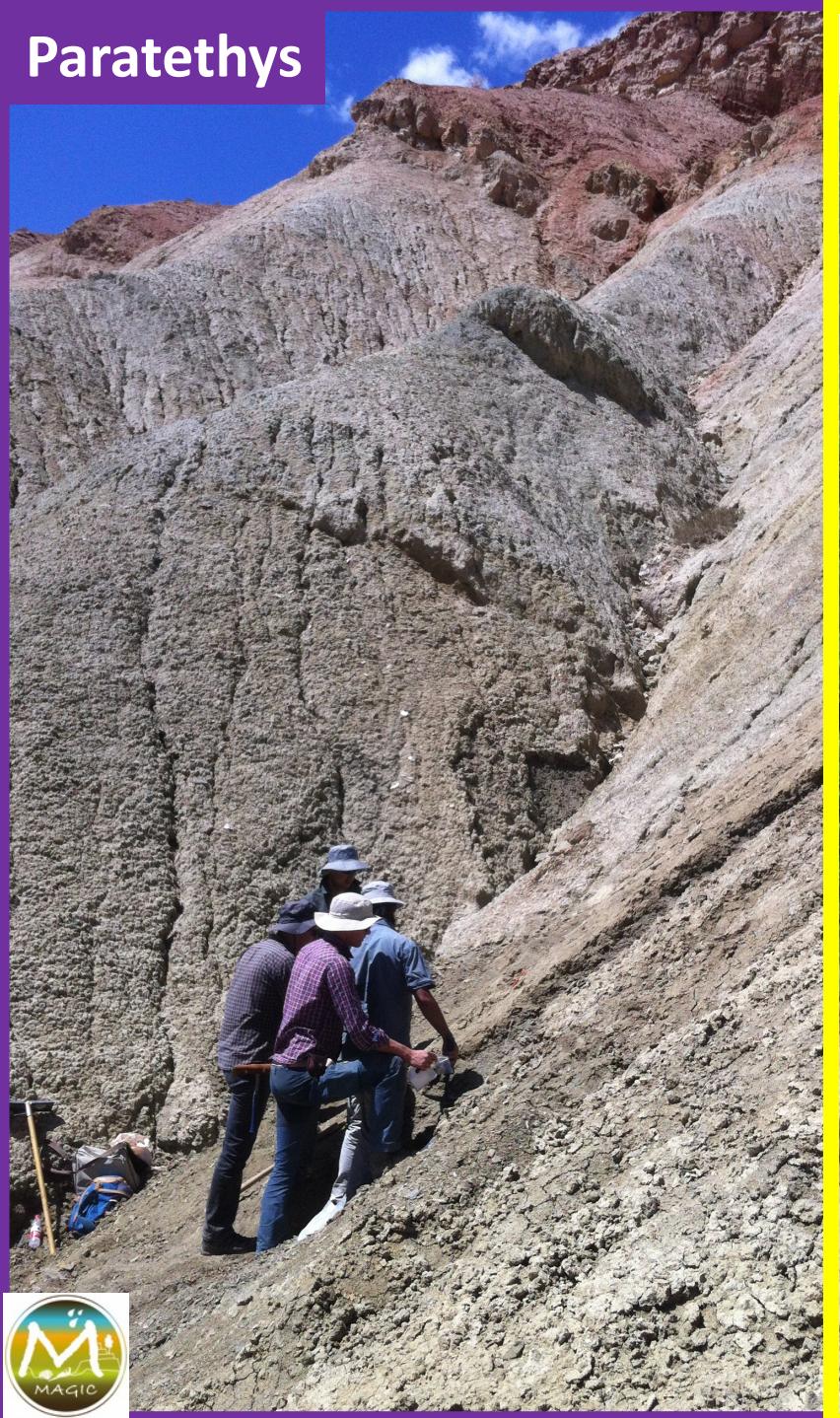
- Fossils and Climate records synthesis.
- Evolution models.



Conclusions and Perspectives

- ✓ Birth and death of proto-Paratethys sea driven by tectonic events.
 - ✓ Asian aridification and dust onset linked to sea retreat and tectonism.
 - ✓ New surprising paleogeography of the India-Asia collision.
 - ✓ Asian monsoons surprisingly different with new paleogeography.
 - ✓ Asian steppe biome highly sensitive to greenhouse-icehouse transition.
-
- Asian fully integrated paleobiogeographic reconstructions for climate sensitivity tests.
 - Comprehensive Asian climate and biotic records and models during greenhouse –icehouse transition (including high pCO₂ EECO and PETM events).

Paratethys



Thank you!



SE Asia

NE Tibet

