### EGU24-19320

Monday, 15 Apr, 16:15–18:00 HALL X2, X2.98



Interactive Portal

# Paleogeographic evolution of Asia in the Cenozoic reconstructed with the Terra Antiqua software



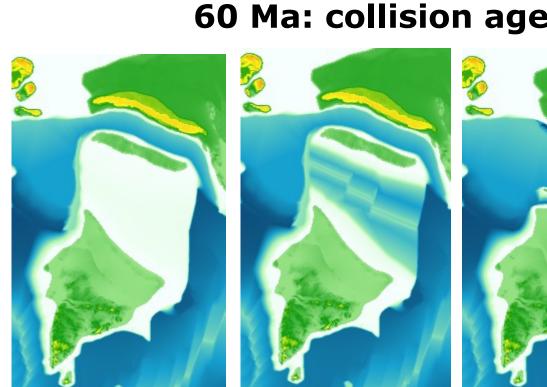


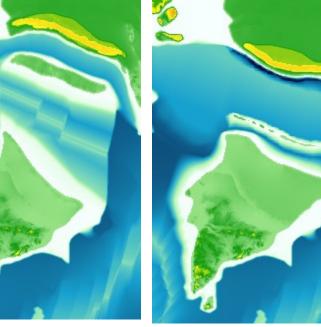
# **1. BACKGROUND & METHODS**

The ability to reconstruct the geologic evolution of the Earth as a system including the geosphere, atmosphere and biosphere interactions, is essential to understand the fate of our environment in the context of the Climate, Life and Energy crises of the new Anthropocene era.

As part of a large project over Asia, we review here the case of the intensely studied, yet still extremely controversial India-Asia collision with major implications on regional and global climate, geodynamic and geomorphic models, mineral formation and biotic evolution. Ongoing debates argue for radically different end-member models of the collision timing and its configuration, and of associated topographic growth in the collision zone.

### 1.a. Fierce debates on the India-Asia collision and uplift of the Tibetan-Himalayan orogen



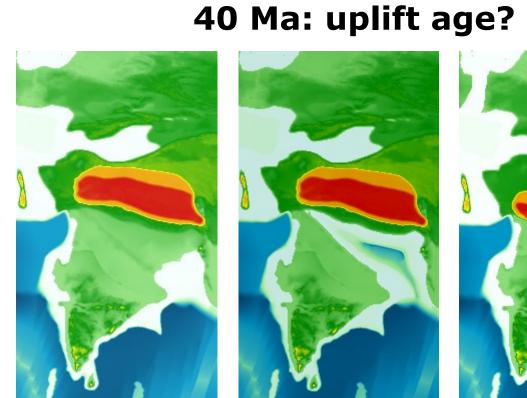


A.Very large B.Greater Greater India Indian Basin

C.Trans-Tethyan arc

Contrasting models of the India-Asia collision are based mainly on paleomagnetic constraints on the size of Greater India and Greater Asia and provenance constraining the age of collisions. 3 main models have been proposed (A,B and C).

Constrasting models of the uplift of the Tibetan-Himalayan are mainly based on paleoaltimetric contraints. It remains unclear if there was a large pre-collisional proto-Tibetan plateau or if the high topography formed mostly during the collision. These constrasing models have major implications for geodynamic, biotic evolution of



### 1.b. Terra Antiqua: Open-source user-friendly QGIS plugin for paleogeography

Terra Antiqua enables to generate and modifiy paleogegraphic reconstrucitons. Each of the following step requires the integration of mutlidisciplinary databases and litterature to guarantee the best possible outcome.

1. Modern topo as starting point.

2. Rotate plates and all data using GPlates at reconstruction age with published or own rotation files and polygons.

3. Bathymetry at reconstruction age from published sources or create and modify modern with Terra Antiqua.

- 4. Compile Topo-Bathymetry tool.
- 5. Set Paleoshorelines:
- Use published or based on databases.
- Interpolation, rescaling and isotopic compensation tools.
- 6. Modify or Create Topo tools:
- Based on data and literature.

- Masks of areas to modify or create (see 1.b. below).

1.c. Example of a Terra Antiqua tools to create topography Three main options to apply to masks:

1. Modify exiting topography (several choice of linear and **Analy Create "realistic" topography** non-lkinear transformations).

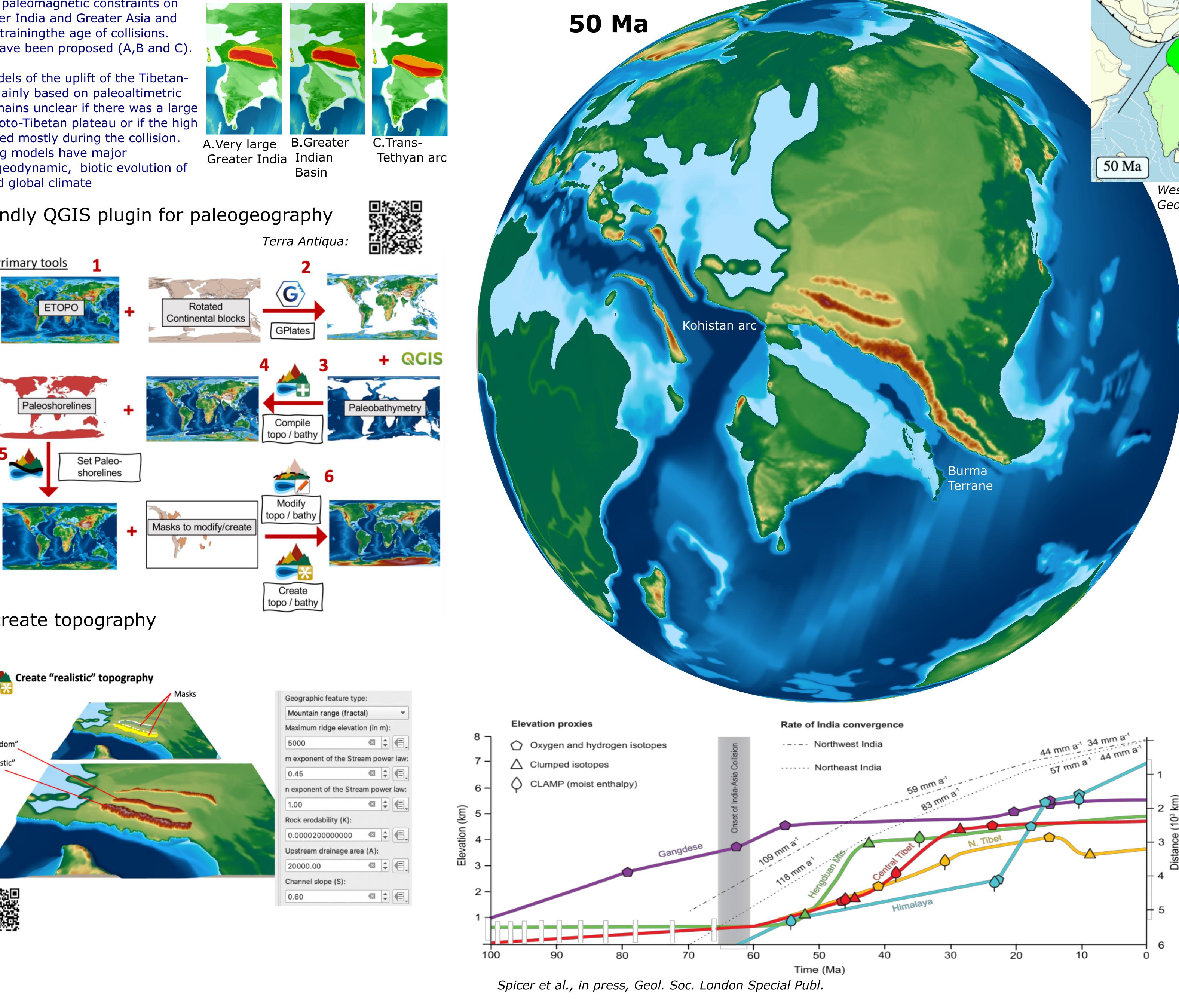
2. Create random points and interpolate (inverse distance weighing).

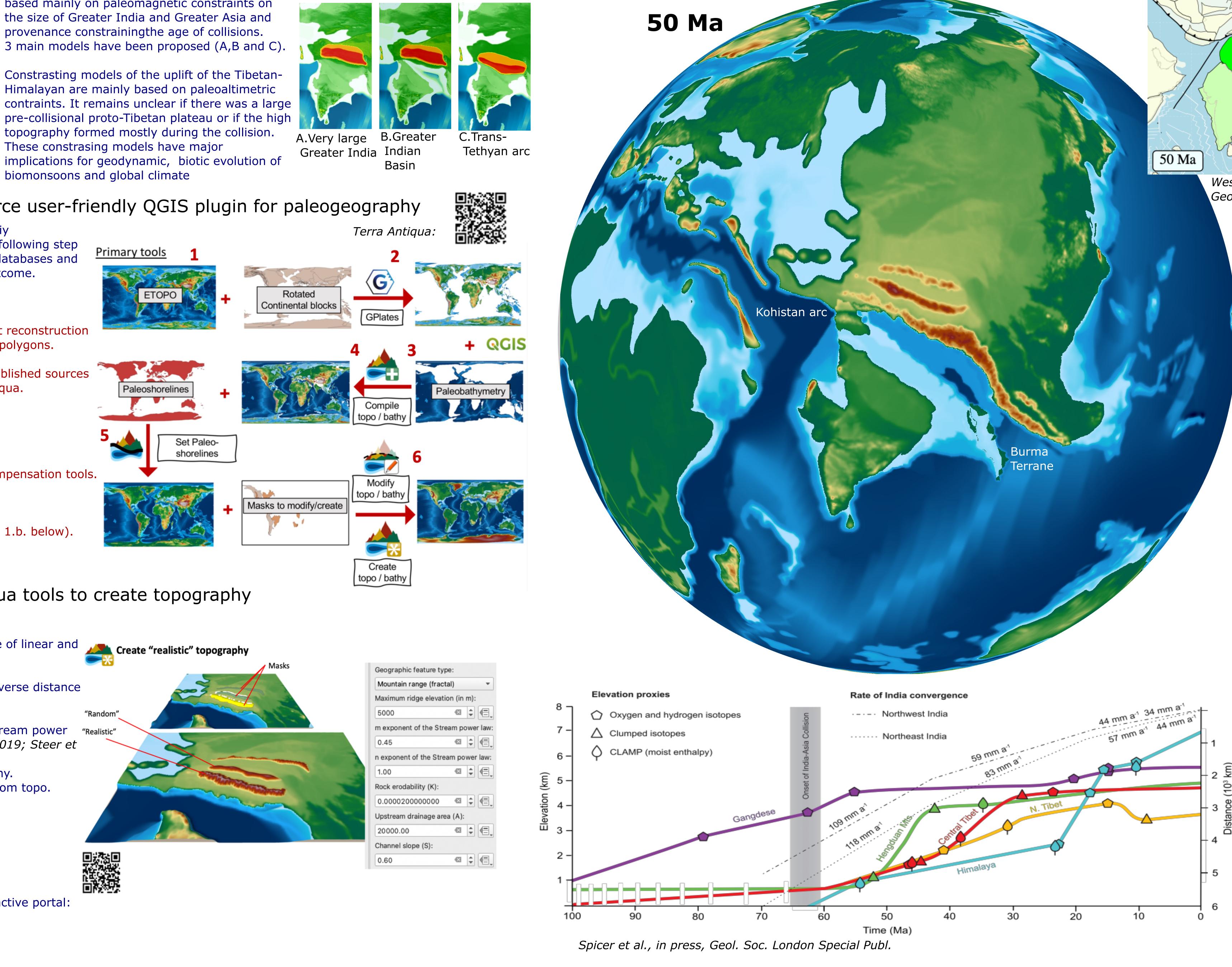
3. Simplified geomorphic generation with stream power "Realistic" law (Cordonnier et al., Earth Surf. Dynam 2019; Steer et al., Earth Surf. Dynam 2021):

- Generate white noise initial topography.
- Implement drainage network on random topo.
- Apply stready state elevation.
- Iterate to equilibrium.

Many other tools to discover!

- Tutorials
- Full manual
- Summer school in Rennes 2025
- Databases and paleogeographies on interactive portal:









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### **2. RESULTS & INTERPRETATIONS**

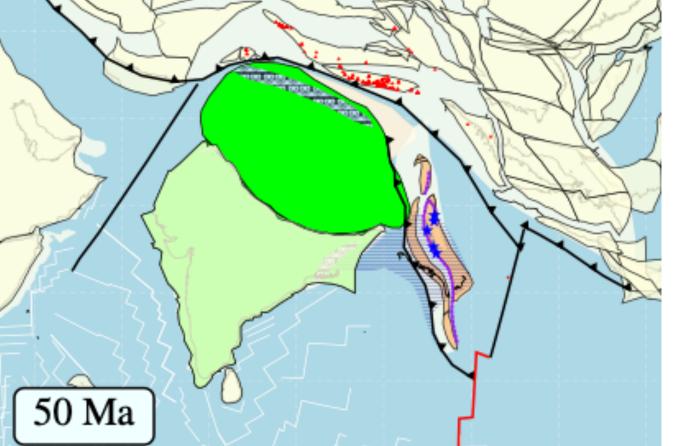
We present new Asian paleogeographic reconstructions made with Terra Antiqua at 50 and 30 Ma that complement an existing set at 60, 40 and 20 Ma (Poblete et al., ESR 2020; Aminov et al., ESR 2023).

These integrate

- the updated Burma Terrane reconstruction with a Trans-Tethyan arc collision (Westerweel et al., in press, Geol. Soc. London Special Publ.), - a large compilation of paleoelevation data with latest CLAMP constraints (Spicer et al., in press, Geol. Soc. London Special Publ.).

Results are provided in an upcoming special volume of the *Geological Society of London, in press.* Reconstructions will be online on our portal (https://map.paleoenvironment.eu/) in various model-relevant formats with associated database and discussion forums to comment an contribute to the amelioration of these maps and databases.

<sup>5</sup>Universität Potsdam, Institute of Geoscience, Potsdam, Germany <sup>6</sup>Deep-time Digital Earth Research Center of Excellence (Zhejiang), Hangzhou, China



Westerweel et al., in press, Geol. Soc. London Special Pul

30 Ma

# **3. FUTURE WORK & PERSPECTIVES**

3.a. Asian paleogeographic reconstructions - Reconstruct other collision configurations (Gretar Indian Basin and Large Greatar India). - Reconstruct other end-member of uplift moedls (proto-Plateau or Basin and Range).

- Revise proto-Paratethys sea reconstruction. · Updates on 60, 40, 20 Ma reconstructions.

3.b. Improvements to Terra Antiqua - Preset tectonic features to be applied in polygones or along lines (passive/active margins, spreading centers, foreland, basins, fold and thrust belts, Basin and range, plateau, etc). - Automatic adjustments of crustal and sedimentary cover deformation upon geodynamic motion (Cordonnier, PhD 2018) following geomorphic rules (Wolf et al., Nature 2022). Implement river drainage networks (Steer, Earth Surf. Dynam 2021) and sediment transpor (Yuan et al., JGE, 2019).

- The user-friendly and open-source Terra Antiqua Q-GIS plugin is currently specifically developed with new tools including data-driven and web-based applications (see presentation of Jovid Aminov, this session)

3.c. Collaboration with the DDE/paleogeographic working group - Intercalibration and comparison with other reconstructions (Vérard et al., this session). - Synchronizing data and reconstructions in the Deep Time Digital Earth and other platforms. - Establishing protocols, standards of reconstruction methodology and implementing them on

- Terra Antiqua and on the DDE platform.

- Including facies maps and formation data from the paleogeography goup (geolex.org; see presentation of Jim Ogg, this session) and integrating reconstructions into this platform.





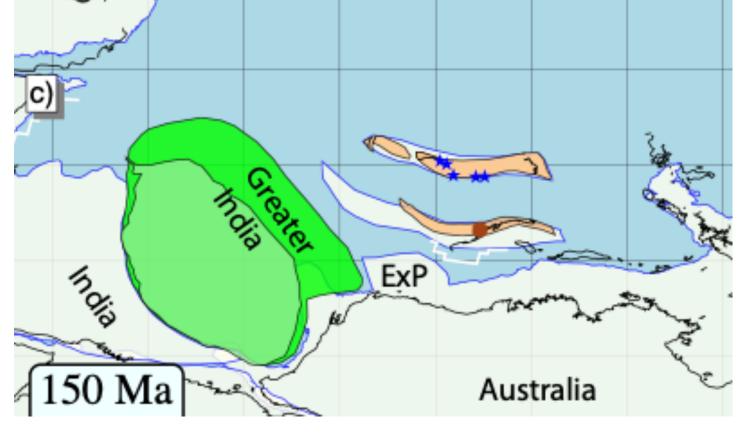


GFZ

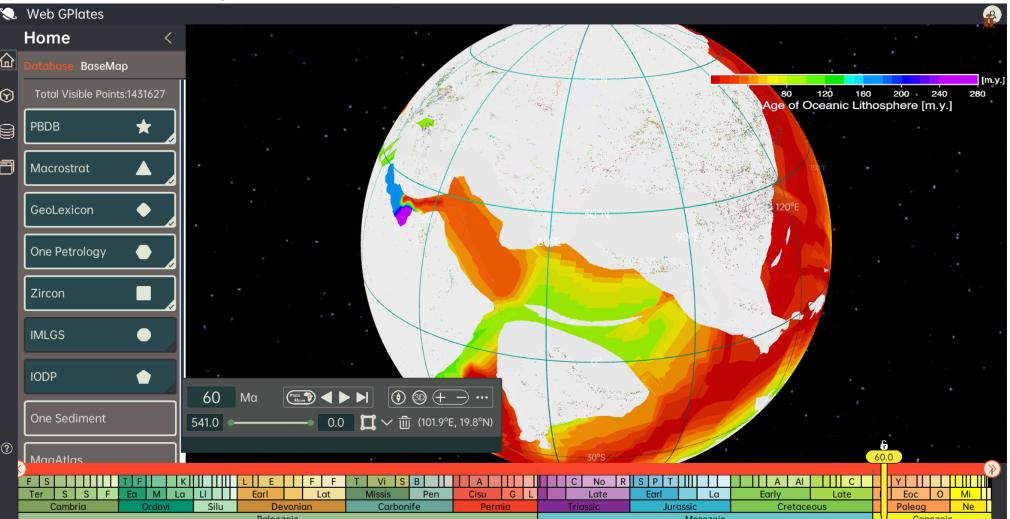
Helmholtz Centre

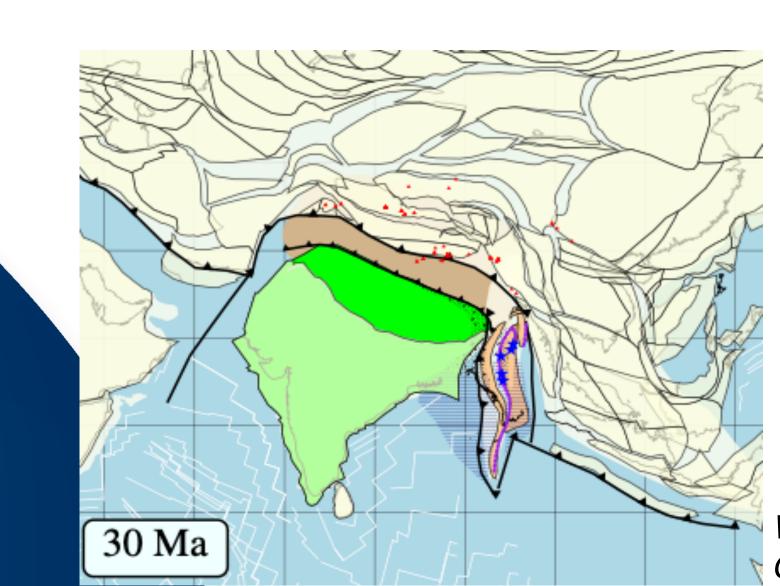
POTSDAM

CNIS



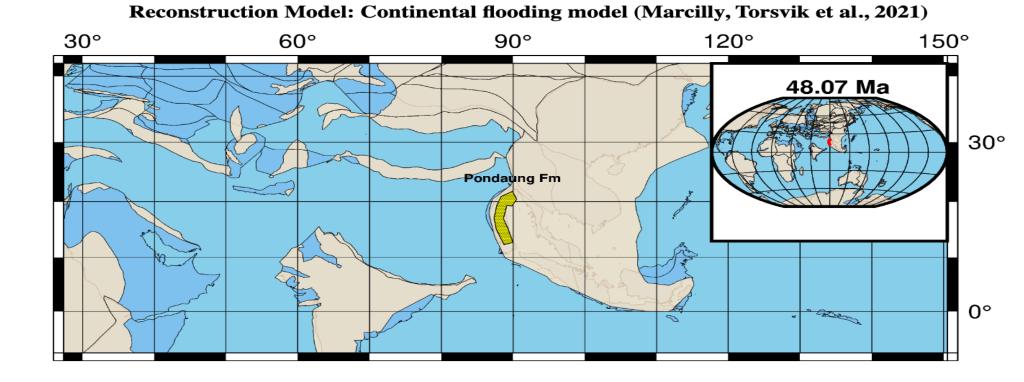
Deep-Time Digital Earth platform





Westerweel et al., in press, Geol. Soc. London Special Publ.

Model intercomparison tested on Pondaung Fm (Burma) Ogg et al., this session



**Reconstruction Model: Paleo-topograph (Chris Scotese, 2018)** 

