The role of bedrock and climate for the Late Quaternary erosive-depositional behavior of an intraplate tropical river: The Tietê River case, southeastern Brazil

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Purpose

- To reveal the drivers of landscape evolution in the study area during the late Quaternary.

(i) What is the relation between the fluvial landscape and major basement tectonic structures?

(ii) How the rainfall variations affect river dynamics through time?

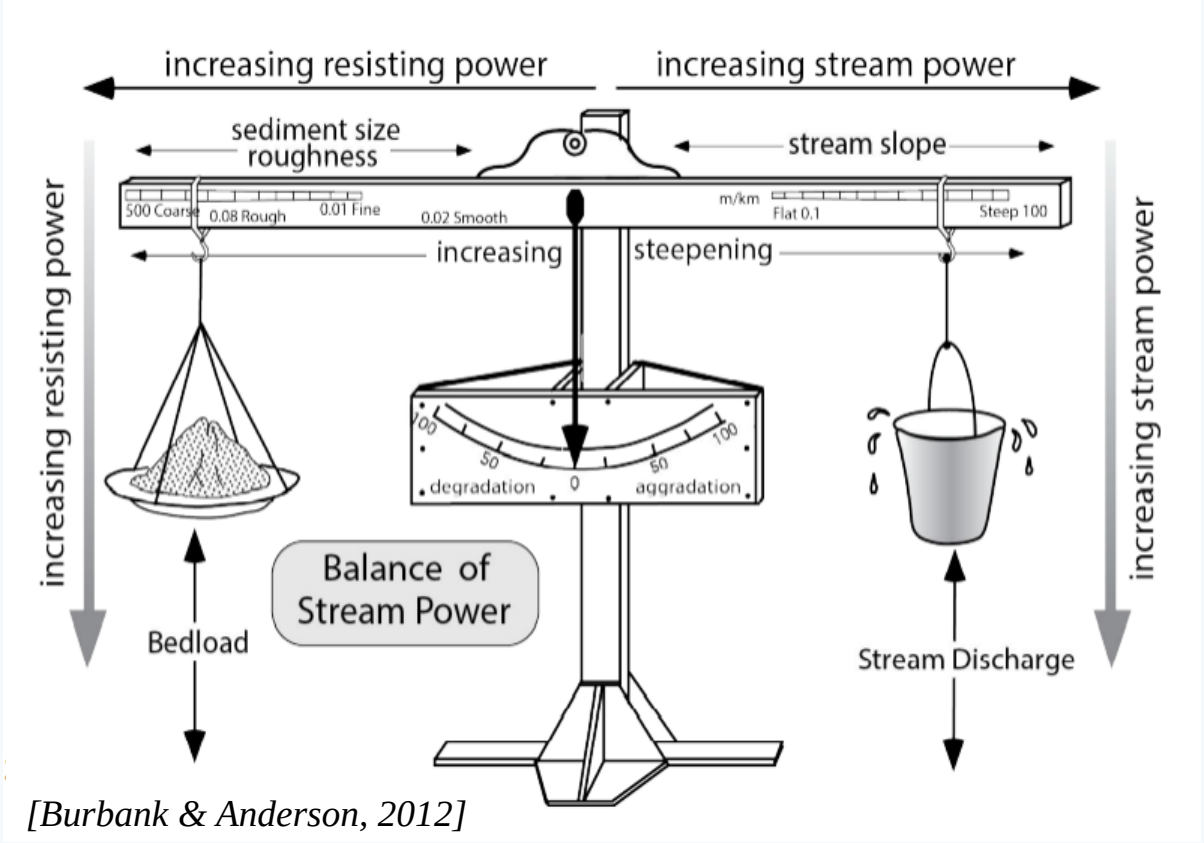
(iii) What are the most important factors for the evolution of the river system?

Basic concept

- Landscape evolution is induced by many kind of surface processes.
- Fluvial systems are important drivers of landscape changes.

Sediment supply<discharge capacity
Incision

Sediment supply>discharge capacity
Deposition



[Burbank & Anderson, 2012]

Basic concept

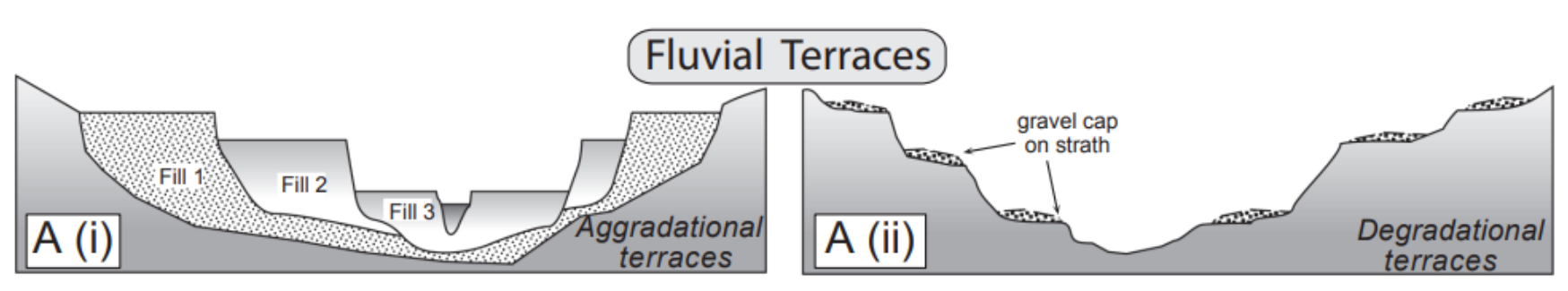
Terraces type

1. Degradational (strath) terrace

- Sediment supply<discharge capacity

2. Aggradational (cut and fill) terrace

- Occurring within a valley already incised into the bedrock
- Sediment supply>discharge capacity



[Burbank & Anderson, 2012]

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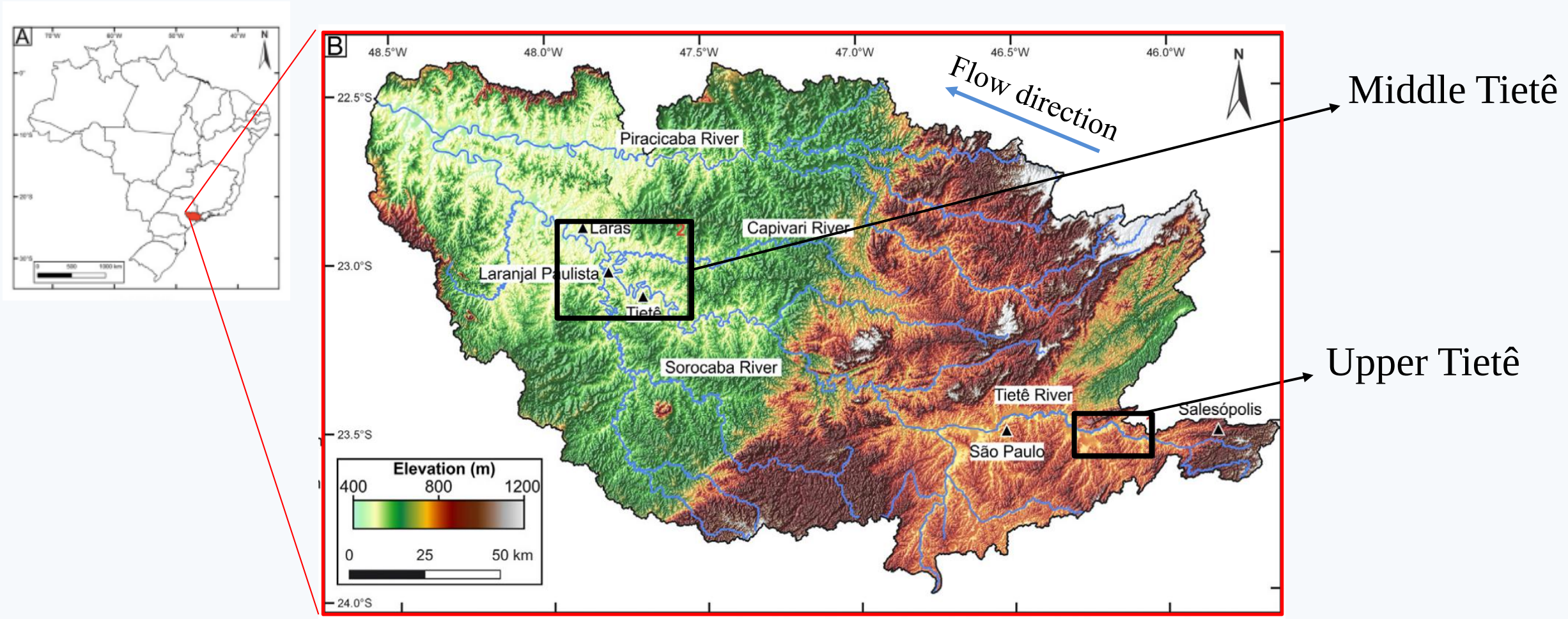
- The Tietê River flows from the east to the northwest.



- Brazil is an intraplate area comprising ancient cratonic basement of the Precambrian age overlain by sedimentary rocks and intruded by igneous activity, as well as impacted by the rifting of the Atlantic Ocean.

Sandstones

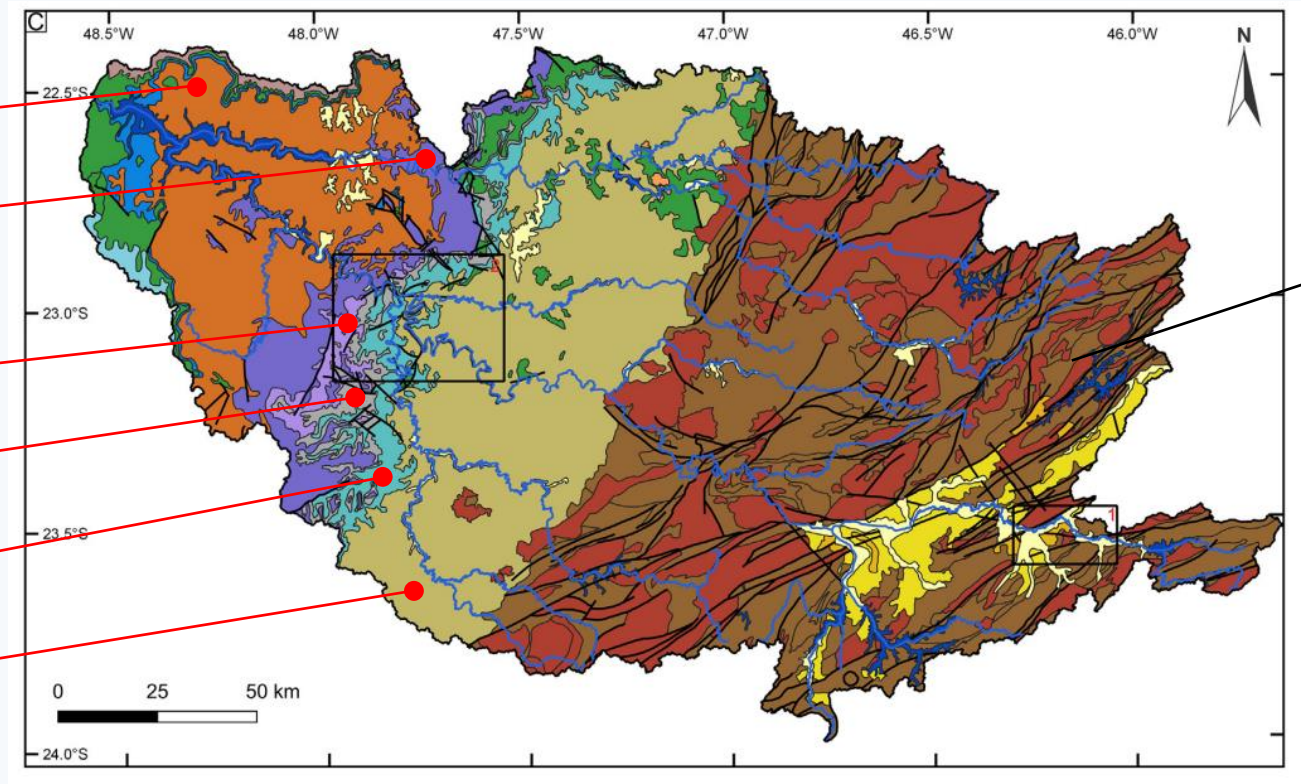
Siltstone-claystone

Shales-siltstones

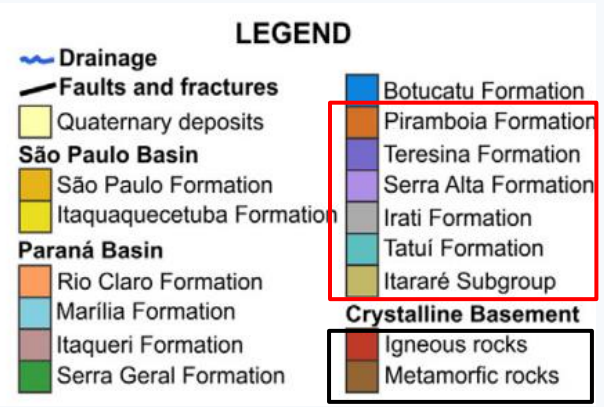
Shales

Siltstones-flintstone

Sandstones-shales



Crystalline Basement



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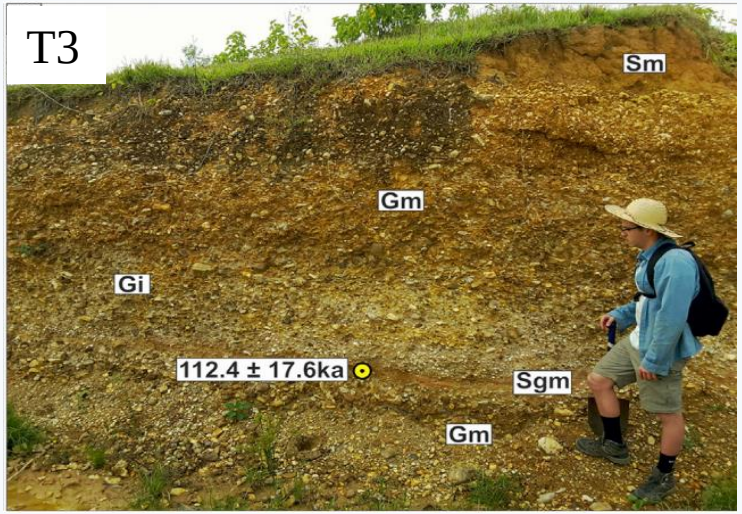

Field trip

- Geomorphic mapping and Sedimentary description (Walker & James., 1992)(using a hand auger)
- OSL dating (burial age)

  Optically stimulated luminescence

Comparing with longitudinal profile, climate and vegetation

Paleo-environment and processes

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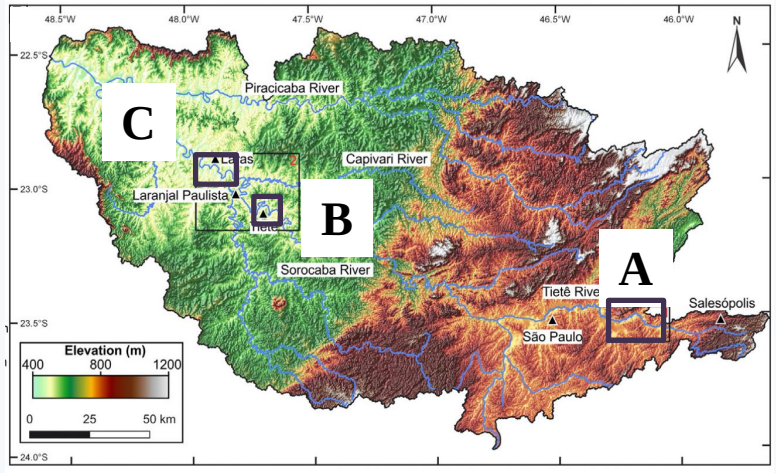
Geomorphic Mapping

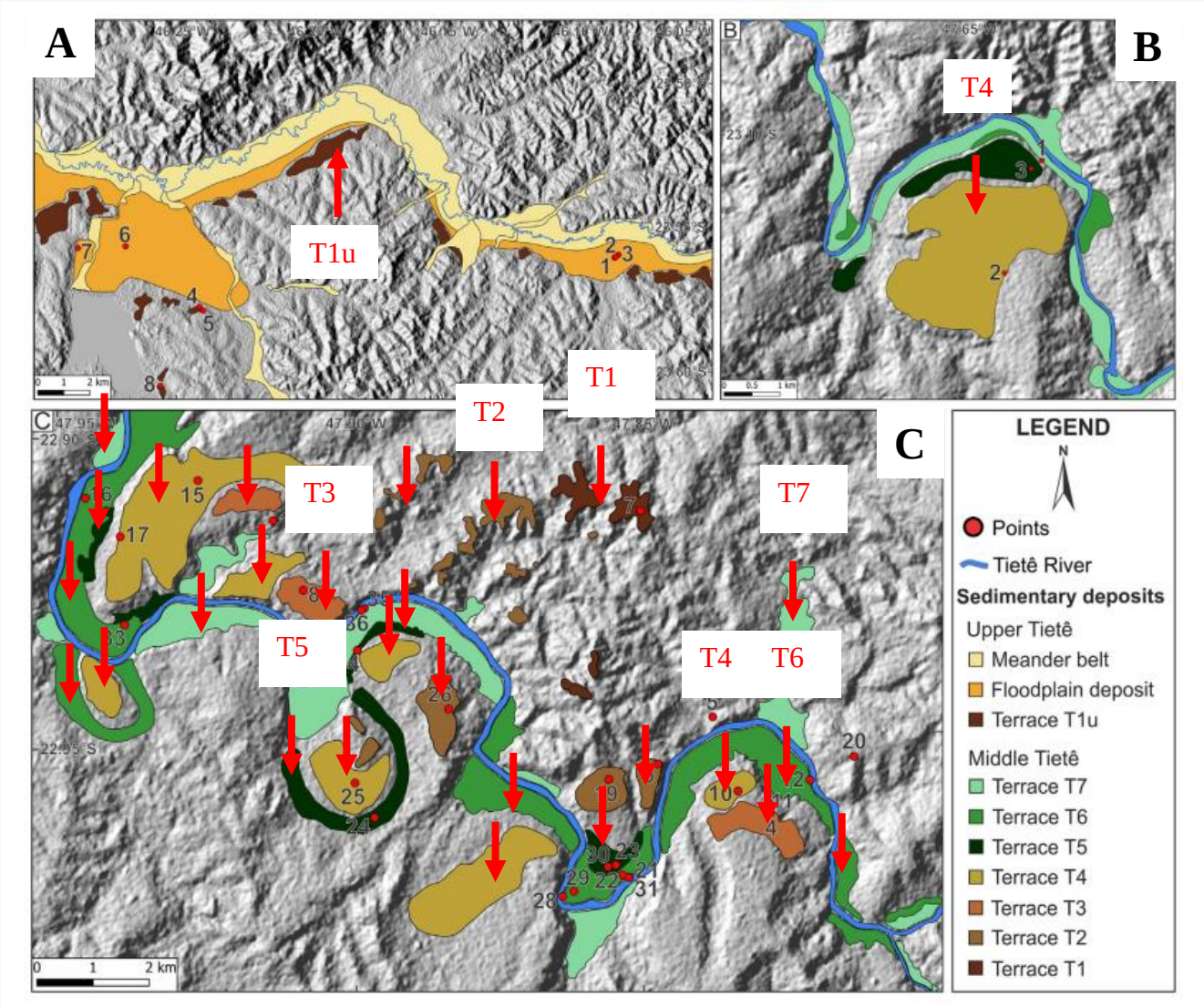


Upper Tietê: T1u

Middle Tietê
High terraces: T1, T2
T1: 85–105 m, T2: 55– 70 m

Intermediate terraces: T3, T4
T3: 45–50 m, T4: 30–42 m

Low terraces: T5, T6, T7
T5:13–20 m, T6: 5–7 m, T7:1-3m



Sedimentary description- Middle river

1. Clastic fragments are as abrasive sediment
2. A large part of the coarser sediments that was retained in the T1-T4.
   →braided channel
   →River can transport the coarse sediment

T5 to modern deposits comprises fine sediments
→ typical meandering channel
→ River cannot transport the coarse sediment

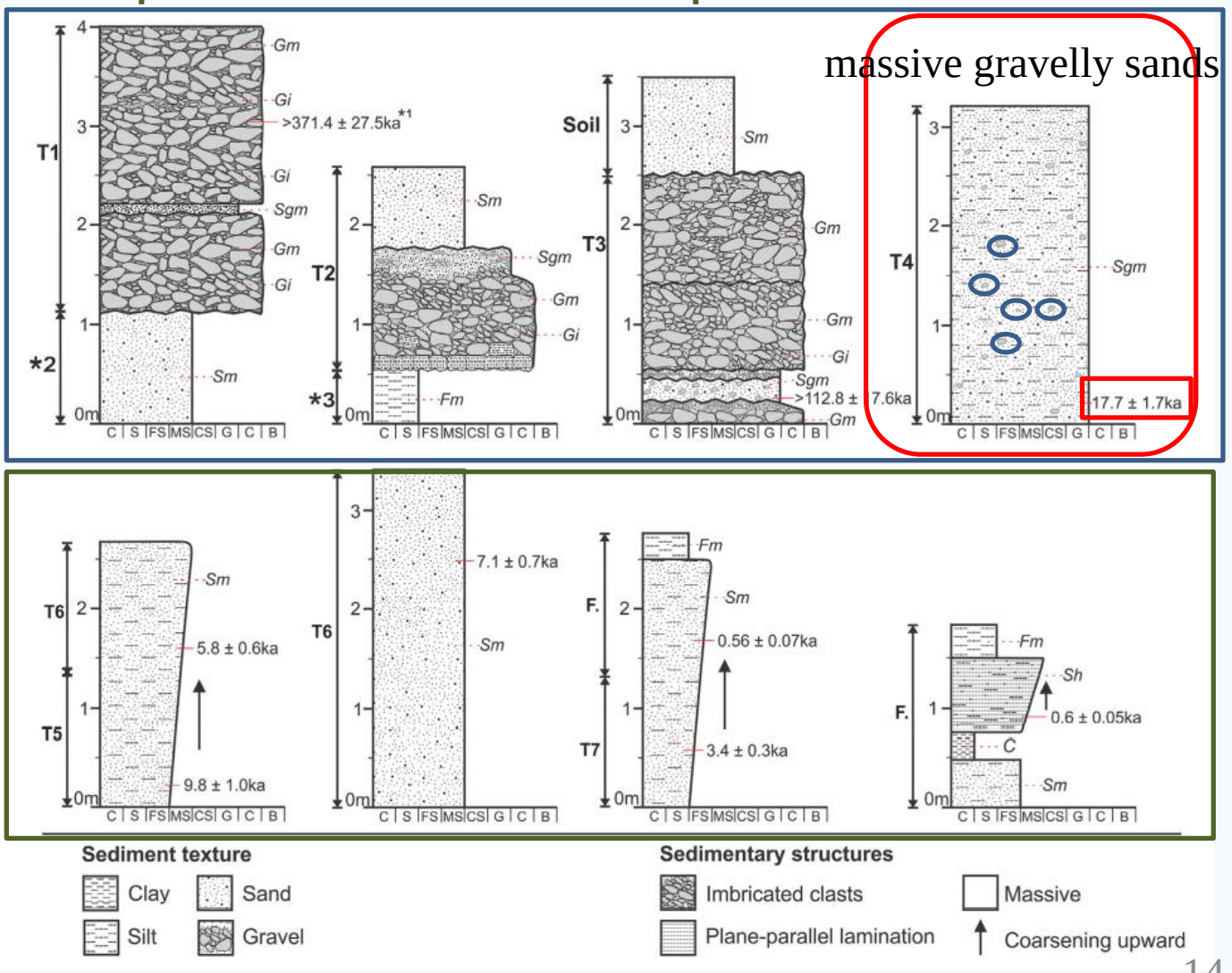
T1-T7

- Gm: massive gravel
- Gi: imbricate gravel
- Sgm: massive gravelly sands
- Sm: massive fine to medium sand
- St: coarse sand with trough cross lamination/stratification
- Sh: dark sand with horizontal parallel lamination
- Fm: silty-clay lenses
- C: clay deposit rich in organic matter

(Walker & James., 1992)

clastic fragments from basement rock

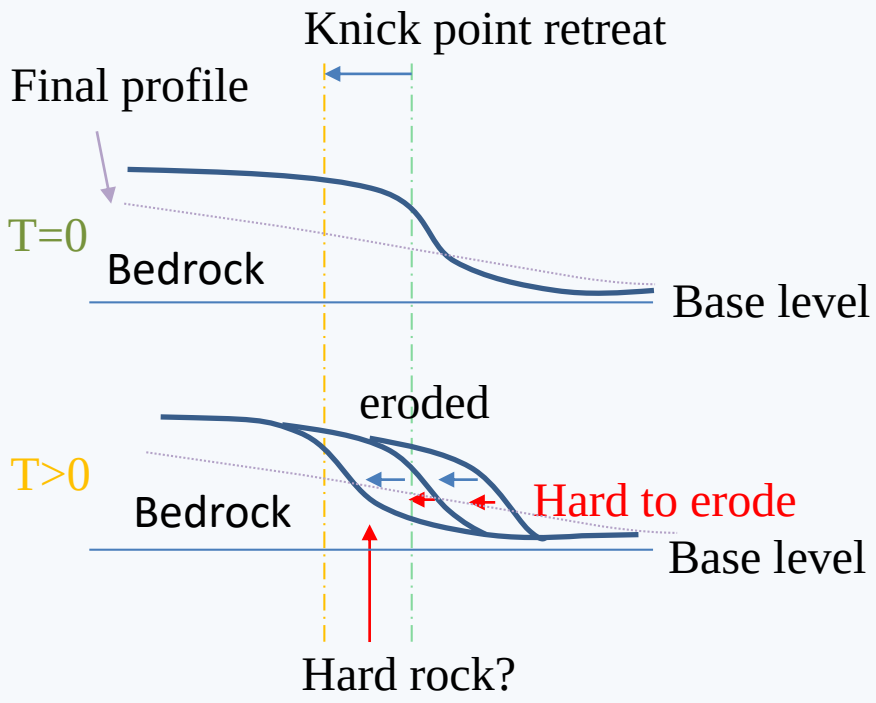
massive gravelly sands

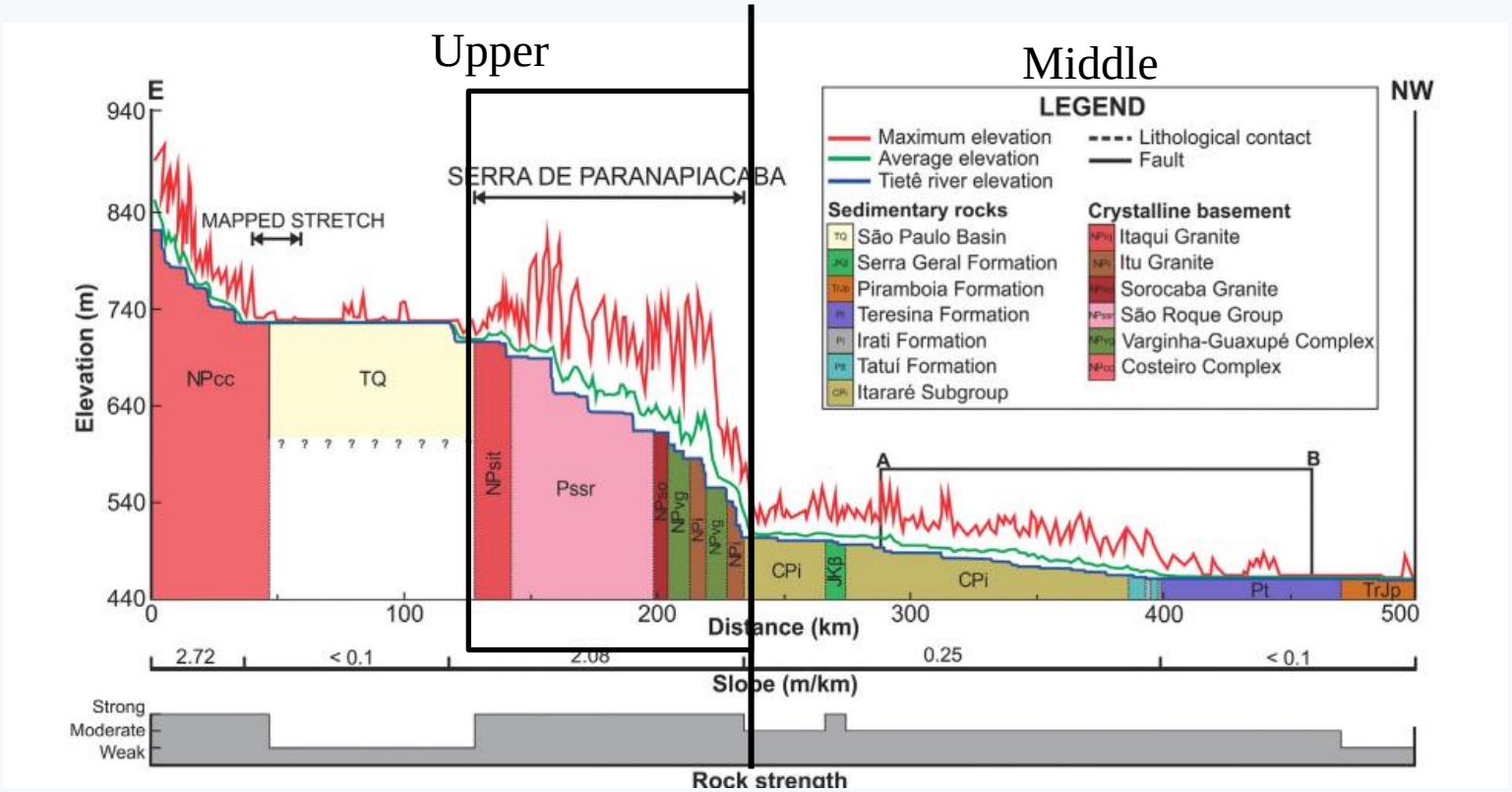


Longitudinal profile

- The different number of preserved terraces between upper and middle river is caused by a litho-structural control.

- The knickzone keeps the regional base level stationary.





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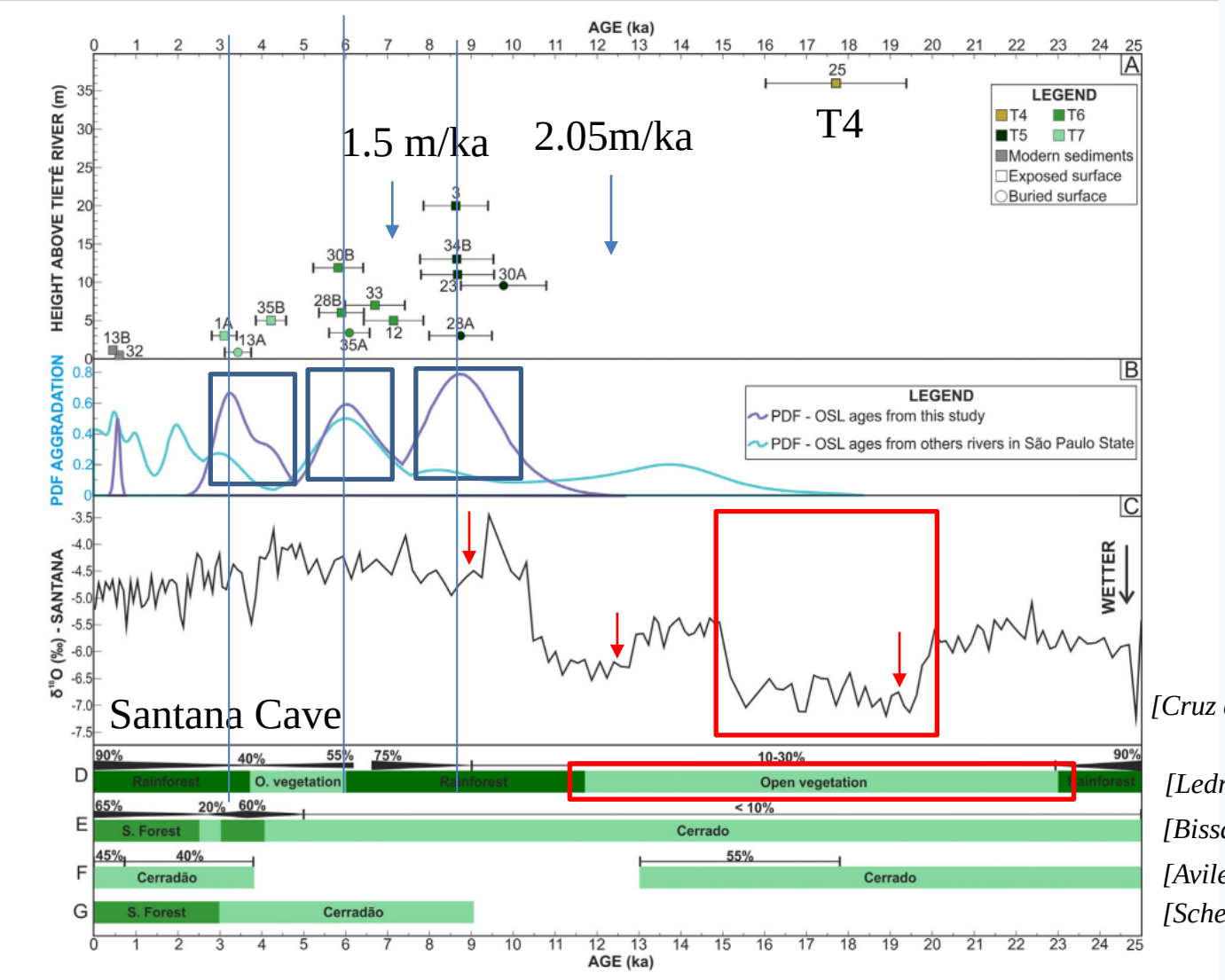
Geochronology

T7 T6 T5

Holocene



~20 to 16 ka
Precipitation increase
Retraction of the rainforest

More vegetation, less erosion
Aggradation increase

Discharge increase

[Cruz et al., 2006]

[Ledru et al., 2009]

[Bissa & Toledo.,2015]

[Aviles et al., 2019]

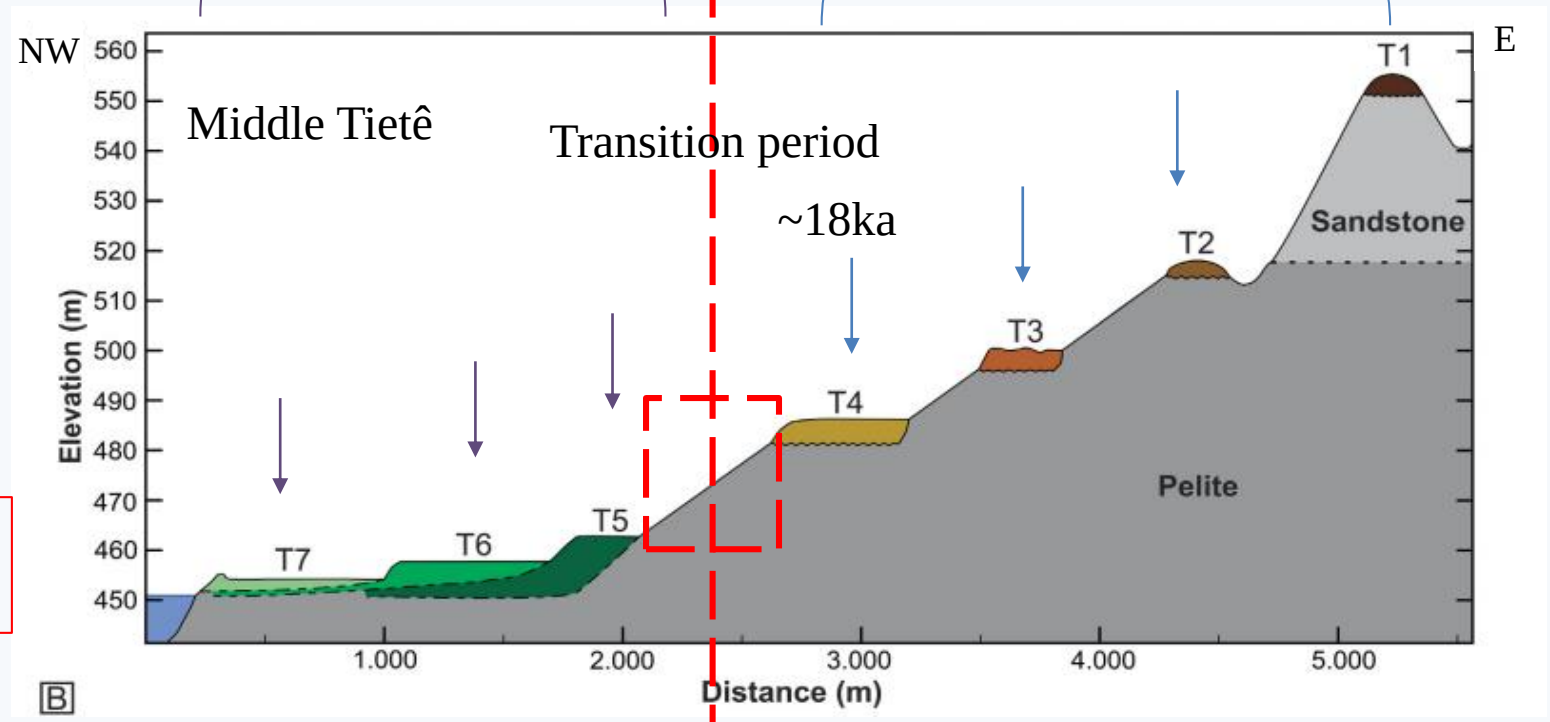
[Scheel-Ybert et al., 2003]

Vegetation increase

Now
Interglacial period
11ka
Deglacial period
19ka
23ka
Glacial period
Time

Cut and Fill terraces

Strath terraces



T5 to T7 indicates less erosive capacity and slower channel dynamics limited by denser vegetation and more stable water discharge.

Sediment supply >discharge capacity

sediment aggradation

T1 to T4 indicates a channel with high capacity to transport coarse grained sediments under drier conditions and sparse vegetation.

Sediment supply <discharge capacity

Meandering

Anastomosing

Braided

retraction of the rainforest

discharge capacity increase (prevailing erosion)

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Conclusions

- The lithological contrast and geological structures control the distribution of terraces in a river that flows over the intraplate terrains.
- The channel incision and terrace abandonment have occurred under relatively wetter conditions.
- The most important factor controlling the Quaternary landscape evolution is the climate.

THANKS

Thank you for your Attention