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Lithological control on topographic relief evolution in a slow tectonic setting (Anti-Atlas, Morocco)

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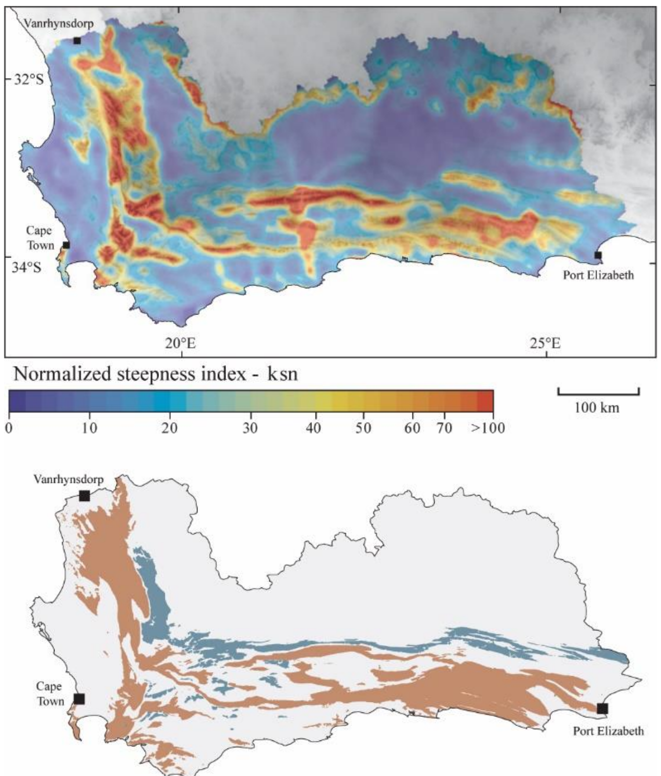
Which parameters control the topography and denudation?

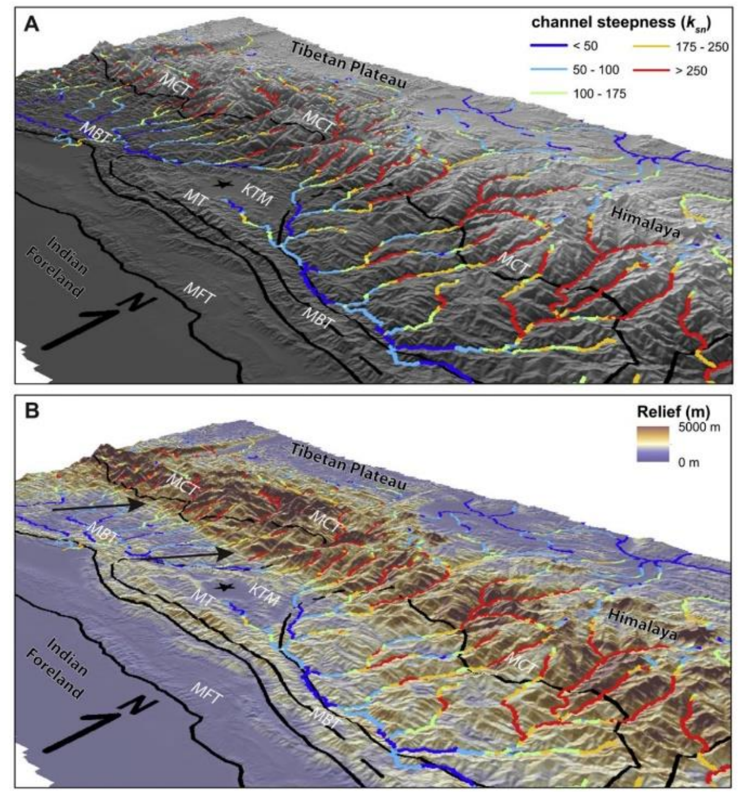
Tectonically inactive settings *vs* **Tectonically active areas**

Lithological control (K)



Scharf et al., 2013

Rock uplift control (U)



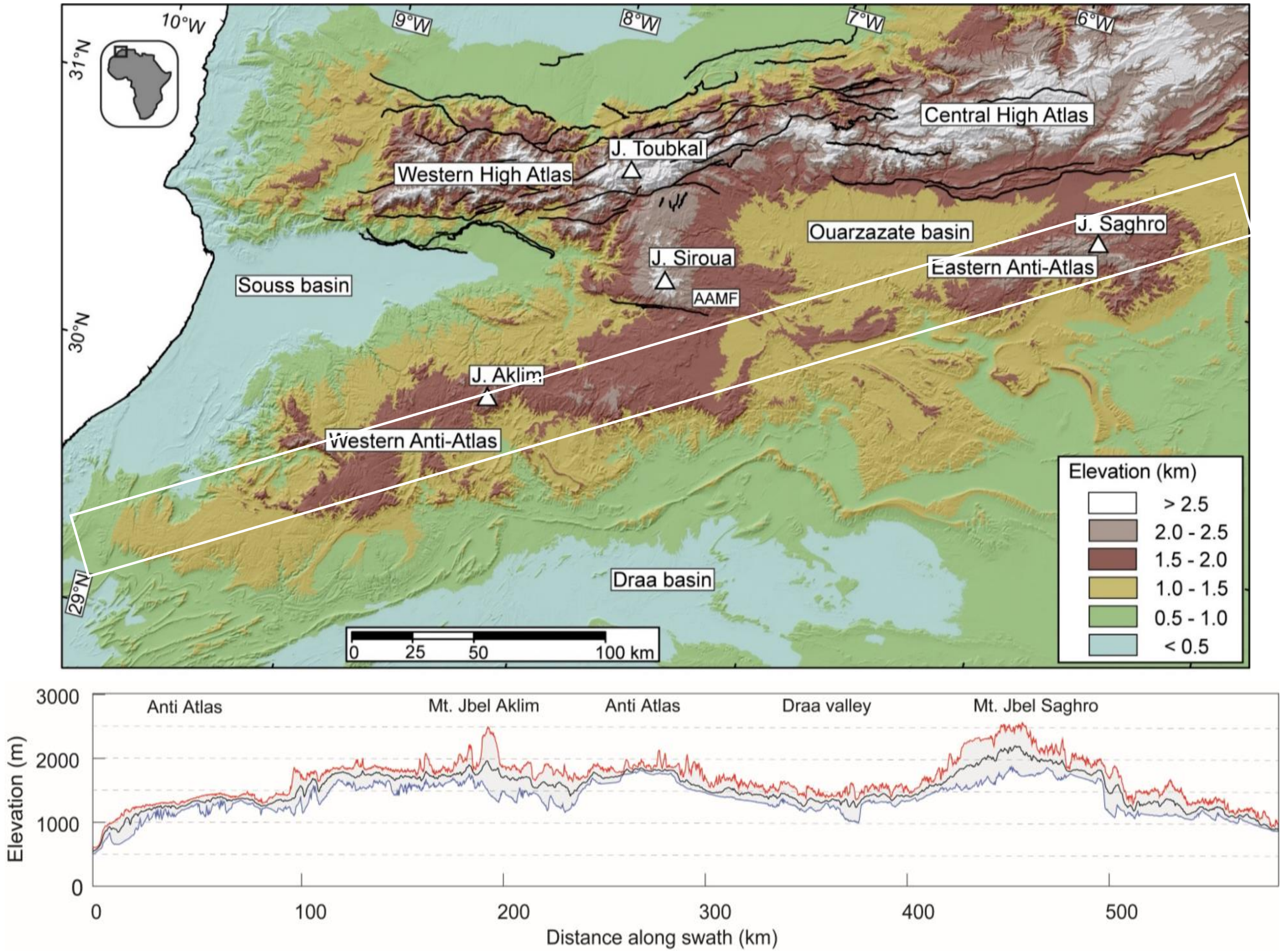
Kirby and Whipple, 2012

Stream power law

$$S = \left(\frac{U}{K}\right)^{\frac{1}{n}} A^{-\left(\frac{m}{n}\right)}$$

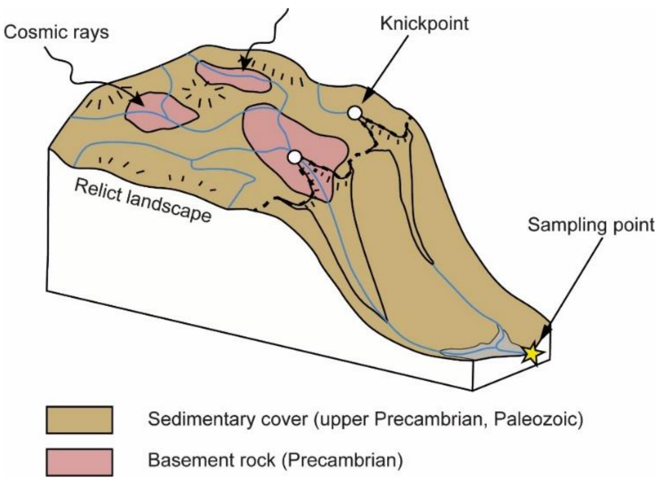
Goal: Quantify the main controlling factors on relief and denudation in the <u>slow tectonic settings</u>

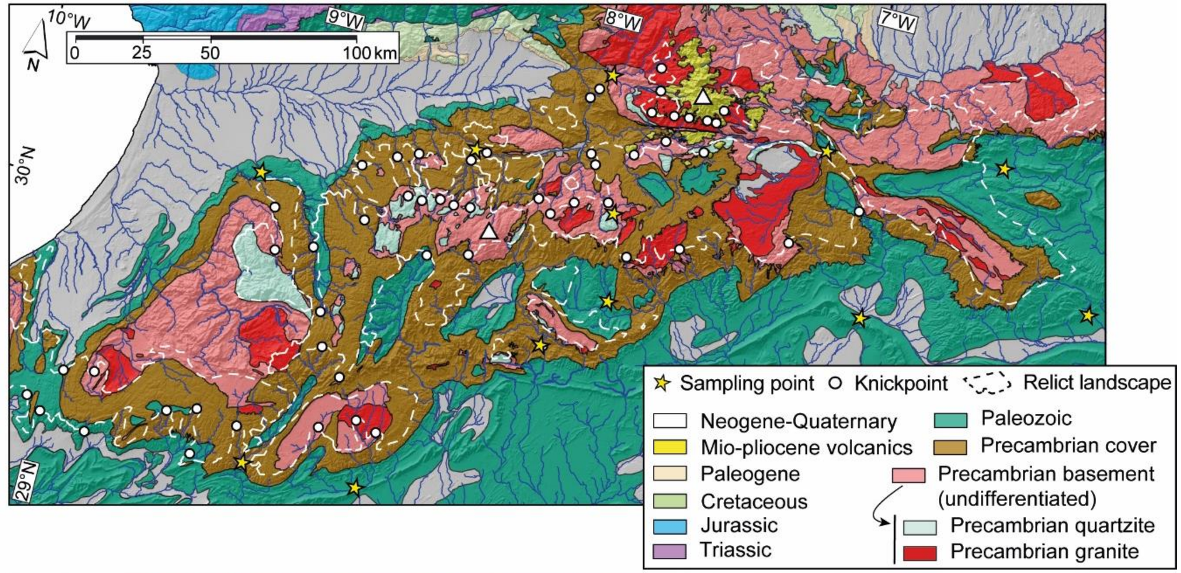
Atlas-Meseta System: an overview

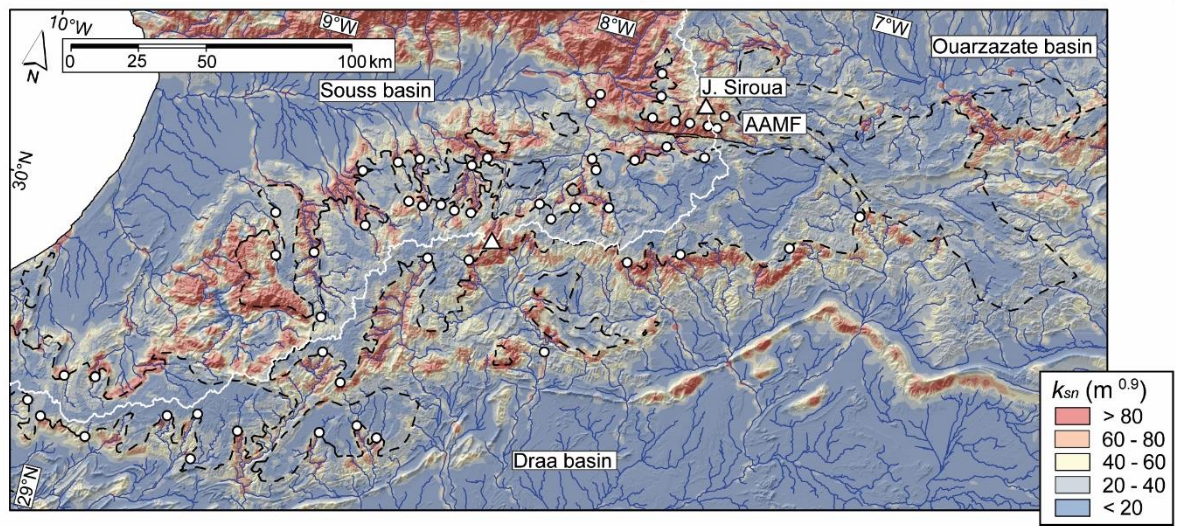


The Anti Atlas is an ancient orogen, uplifted initially during the Variscan orogeny (Late Paleozoic). This range show a recent phase of late Cenozoic surface uplift. His topography reach more than 2000 m and shows a wide erosional surface at the maximum topography.

Anti-Atlas relict landscape





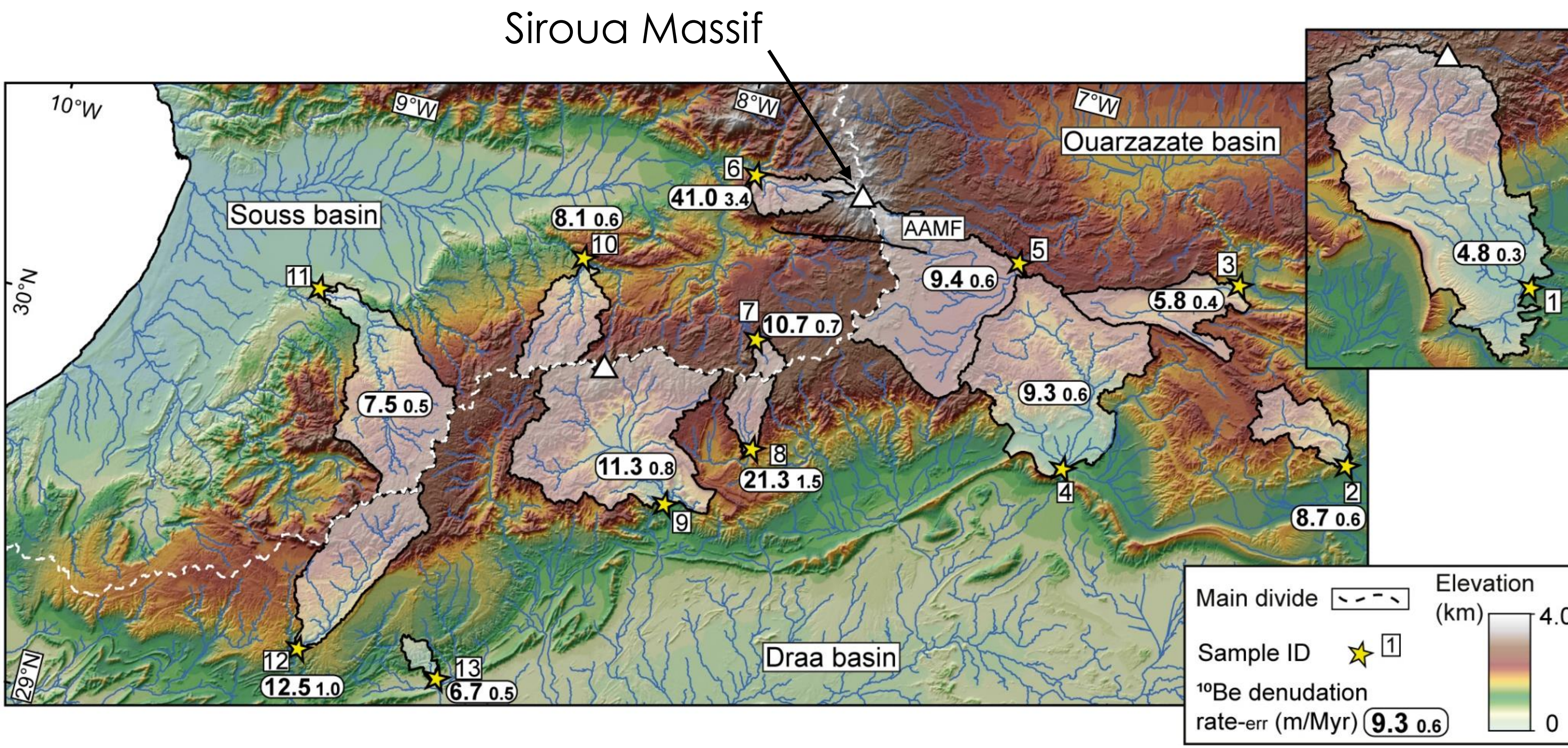


We performed a topographic analysis, an analysis of the outcropping lithologies and we estimated denudation from ^{10}Be comogenic from active river channels.

Denudation rates are mostly representative for the upstream relict landscape, where are located the main quartz-bearing rocks

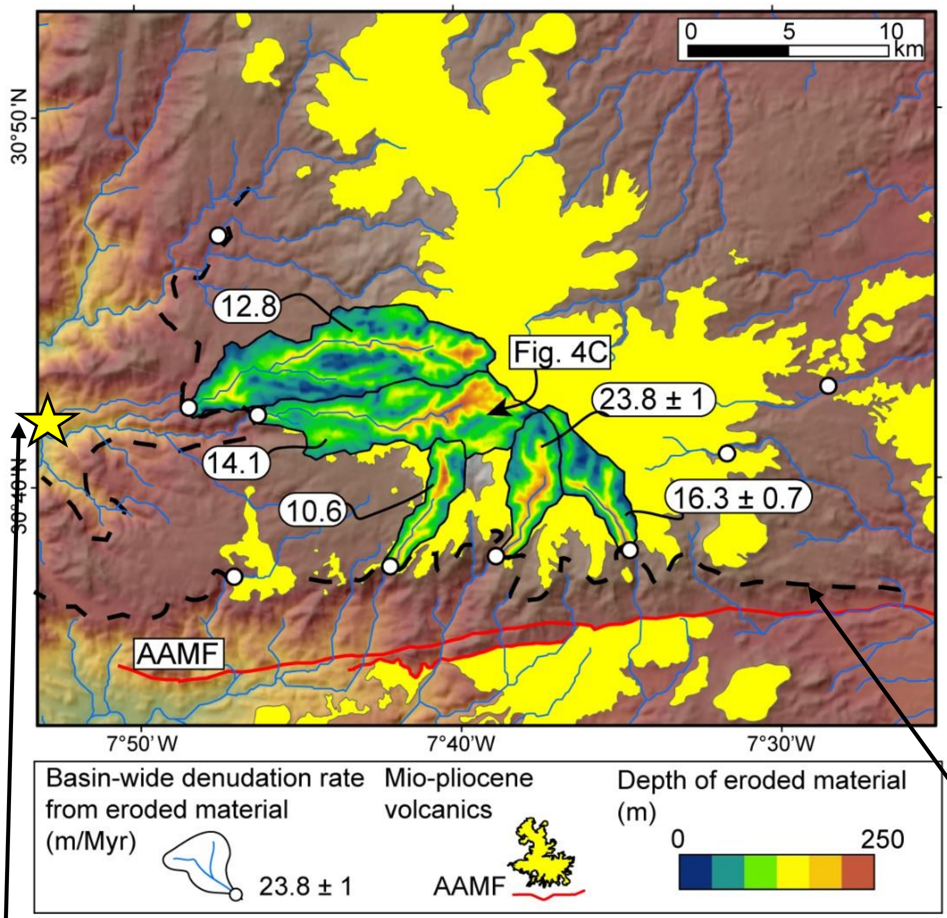
Anti-Atlas denudation rates

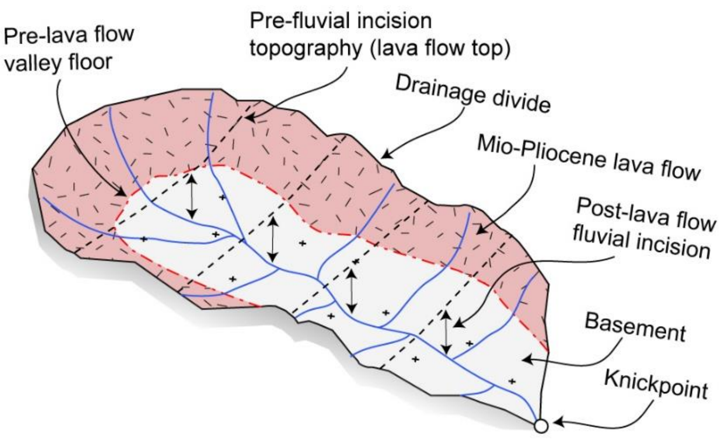
Basin-wide denudation rates (^{10}Be)



Basin-wide erosion rates are consistently low, and range between 5 and 20 m/ Ma over a time scale of ca. 70 ± 40 ky.

Longer-term denudation rates from eroded volcanics





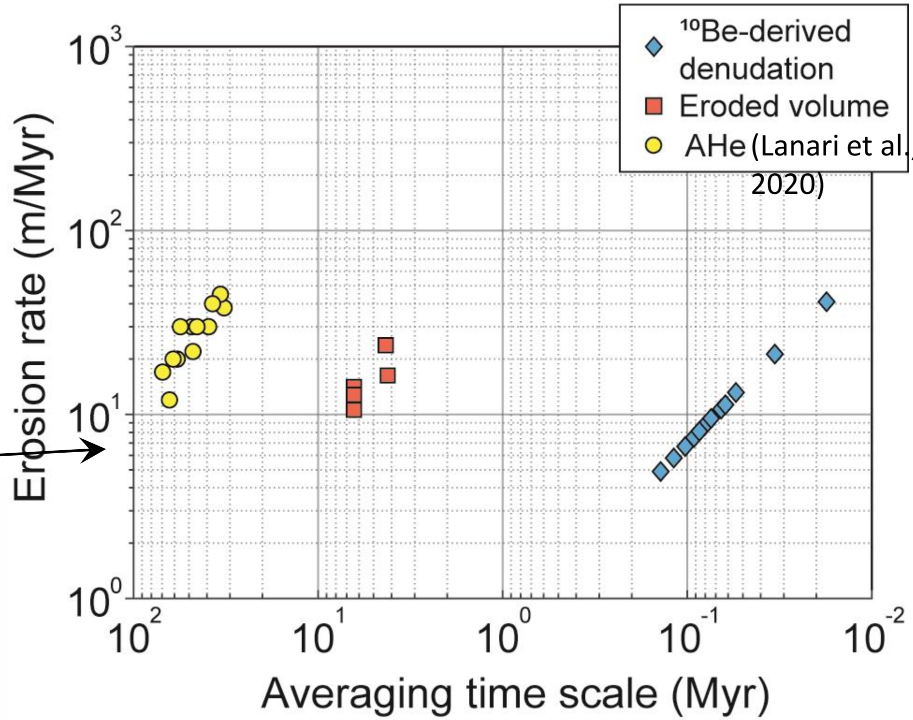
Basin-wide erosion rates range between 10 and 20 m/ Ma over a time scale of ca. 5 Myrs.

Relict landscape

40 m/Myr (10Be-derived denudation)

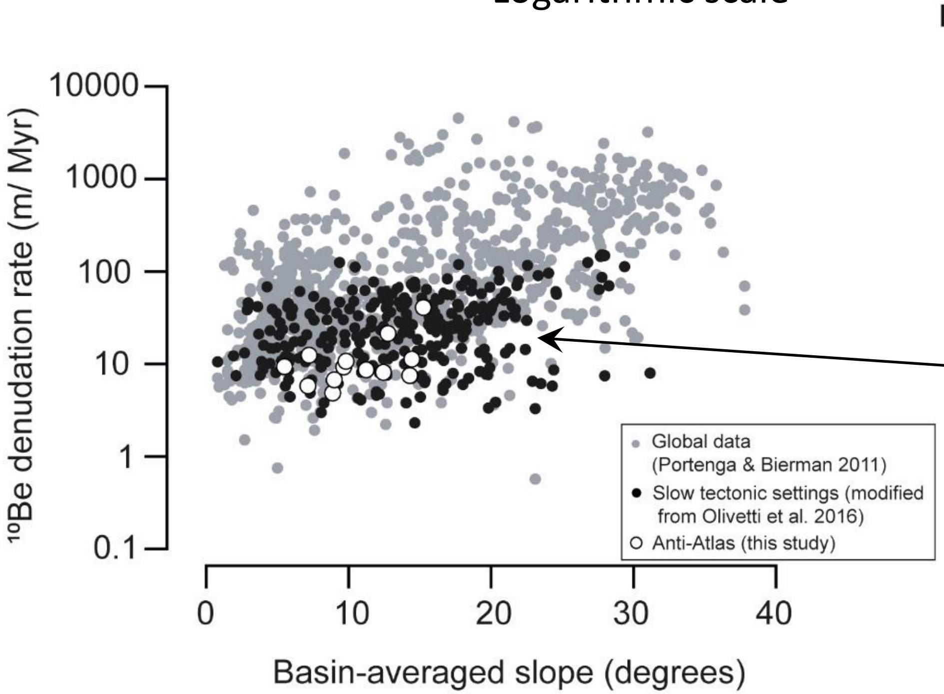
Denudation rates across time scales

It has been stable since the late Cretaceous (Erosional steady-state)



(Lanari et al., 2020)

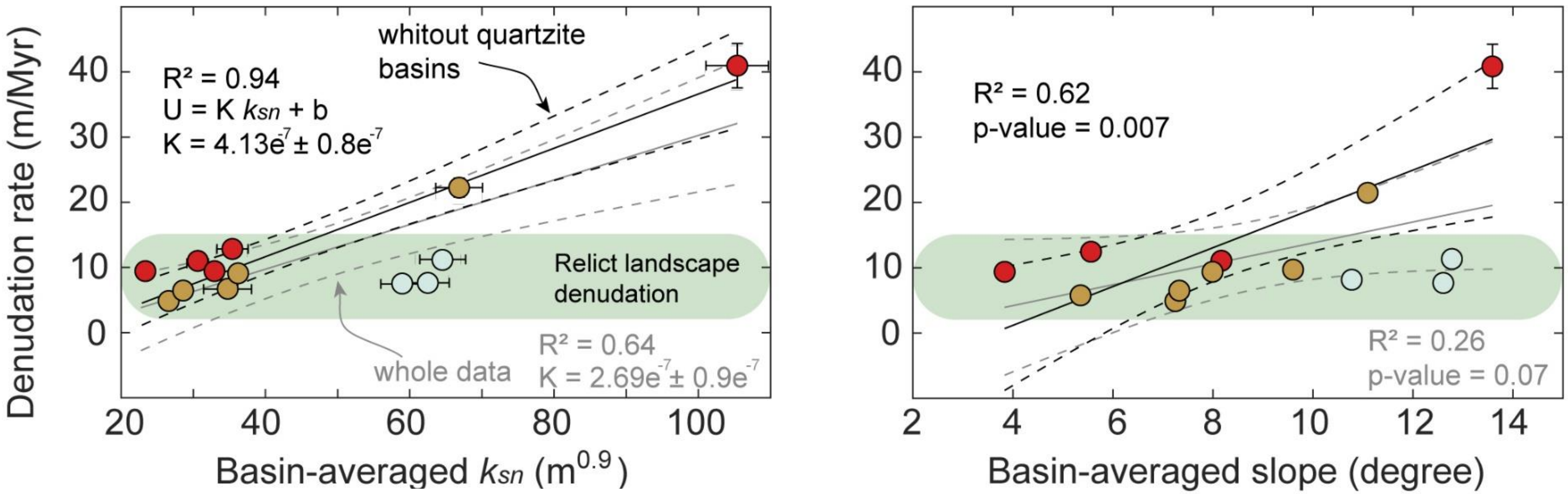
Logarithmic scale

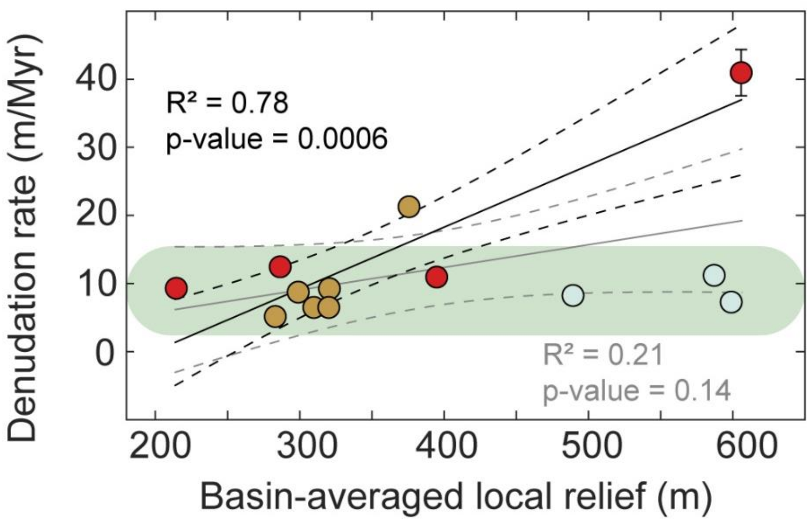


Denudation rates in the order of stable and inactive tectonic settings in the uplited relict landscape

1. Erosional steady-state?

Denudation vs k_{sn}/ slope/ relief/ precipitation





Quartzite-dominated catchments show higher values of granitic and sedimentary basins, in the relict landscape. Granite-domanated catchments, conversly, show lower values of metrics and channel steepness considering the same range of denudation rates.

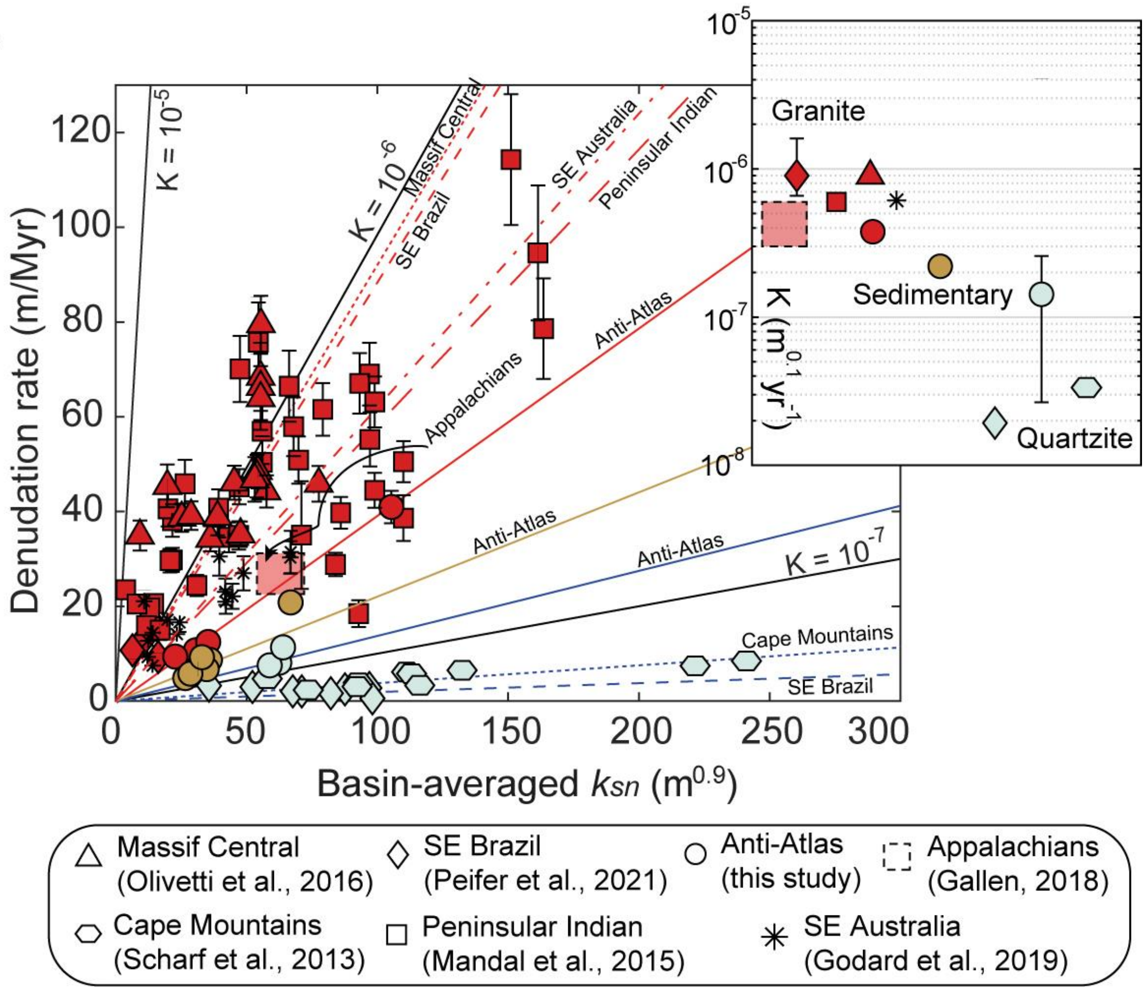
Conclusion 2: Lithological control on the topographic relief

Denudation vs k_{sn} : a global view

Global compilation of slow tectonic settings

$$\boxed{dx/dt} = \boxed{K} A^m$$

E/ ksn



We observe a global scale relationship where lithology of the catchments controls the channel steepness and denudation rates relationship. Moreover, estimates of erodibility fall in a narrow range for different settings. Interestingly, this data come from regions characterized by different climatic and precipitation condition, but this seems not play any role in erodibility estimates.

Conclusion 3: Climate does not seem to influence the erodibilty parameter (*K*) in slow tectonic settings

Thanks for your attention

Conclusions

1. Erosional steady-state? (Anti-Atlas)

2. Lithological can control the topographic relief in slow tectonic settings

3. Climate does not seem to influence the erodibilty parameter (*K*) at in slow tectonic settings