In situ 14C-10Be disequilibrium suggests a recent and major denudation event of French Massif Central, despite slow tectonic deformation.

Controls on DENUDATION:
Uplift
Climate
Human beings and life
Lithology
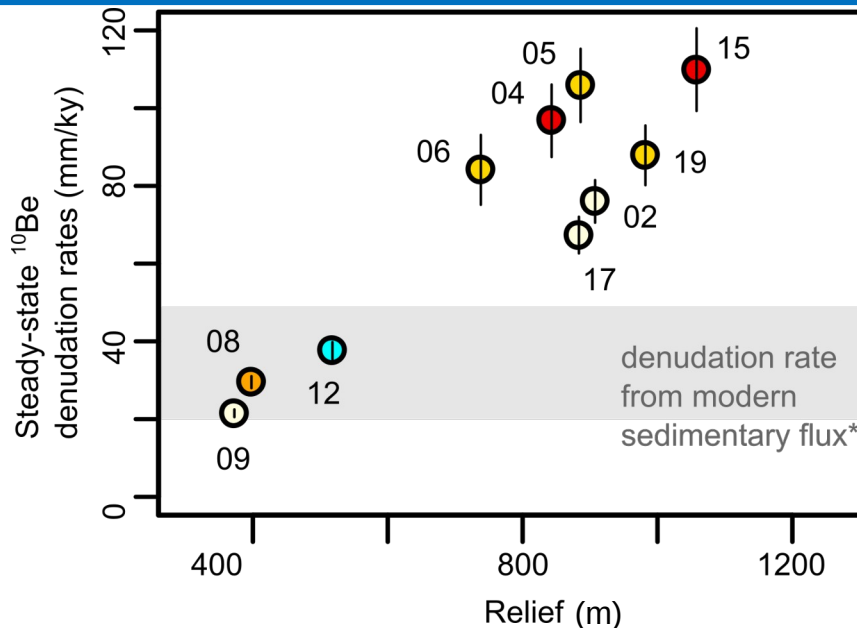
Hypothesis:
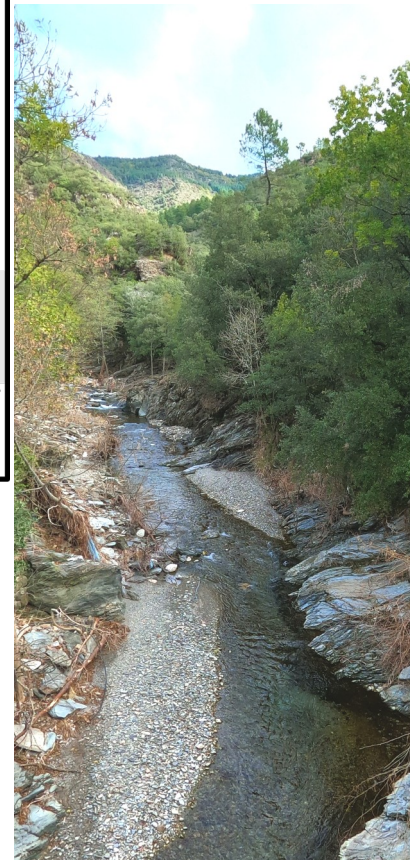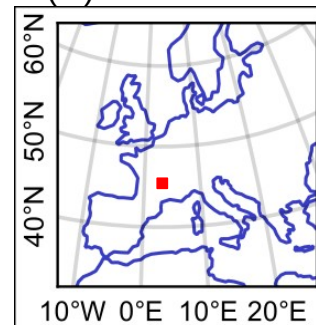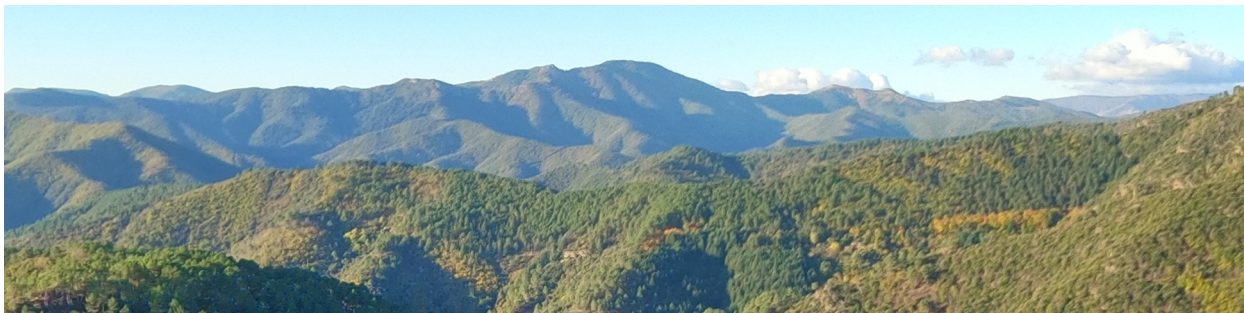Controls have changed
↓
Rates have changed?

This study:
We tested a simple mountain range
Very slow tectonics, limited glaciations, known human activity
^{10}Be concentration data are available**
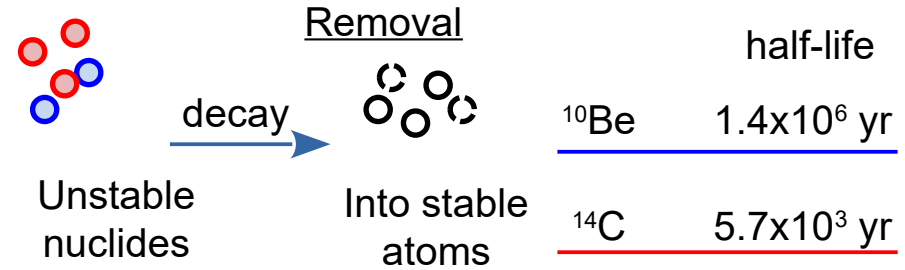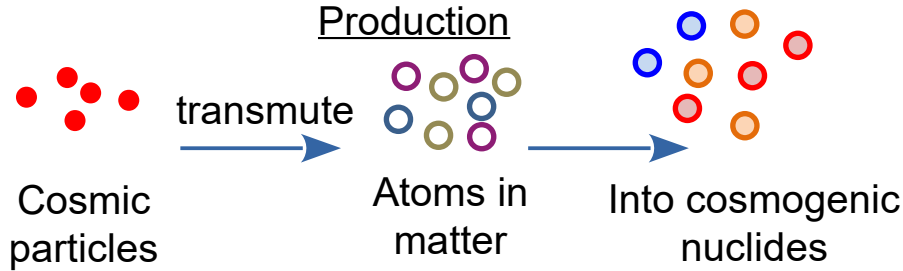We used the in situ ^{14}C-^{10}Be pair on river sediment

*Molliex et al. 2016, **Desormeaux et al., 2022

denudation rate from modern sedimentary flux*

26 May. 2022

S.J.P. Lenard, M. Lupker, I. Schimmelpfennig, V. Godard, C. Desormeaux, N. Haghipour, L. Wacker, G. Aumaître, K. Keddadouche, D.L. Bourles

Concentrations in rocks integrated over time of denudation to surface*

<u>Production</u>

transmute

Cosmic particles → Atoms in matter → Into cosmogenic nuclides

<u>Removal</u>

decay

Unstable nuclides → Into stable atoms

half-life

^{10}Be 1.4×10^6 yr

^{14}C 5.7×10^3 yr

Production in crystalline network (in situ) depends on <u>thickness and density</u>

*depends on <u>denudation rate</u>

In situ produced within crystals, with a protocol to remove organic C14
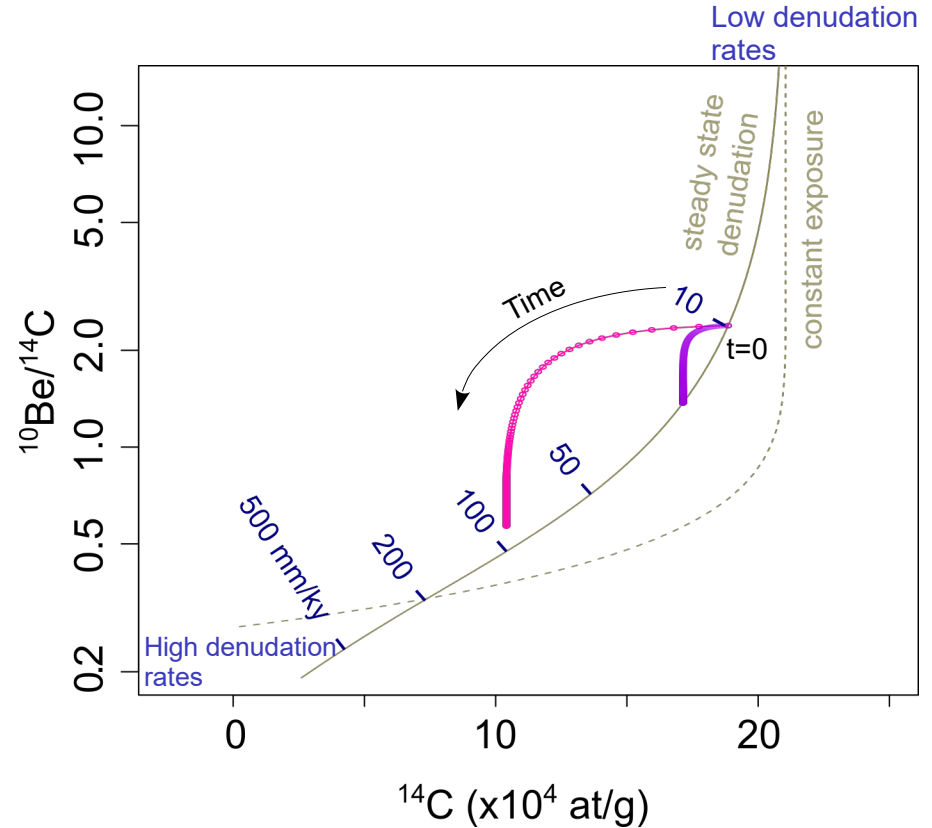
$\varepsilon = 0.1$ mm/yr

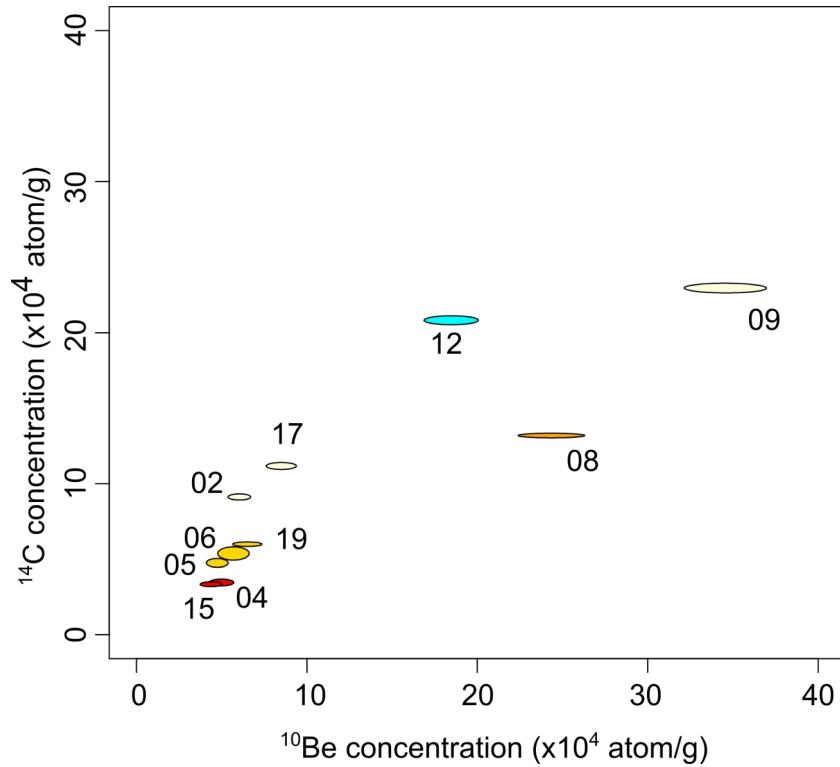— ^{10}Be
— ^{14}C

depth (m)
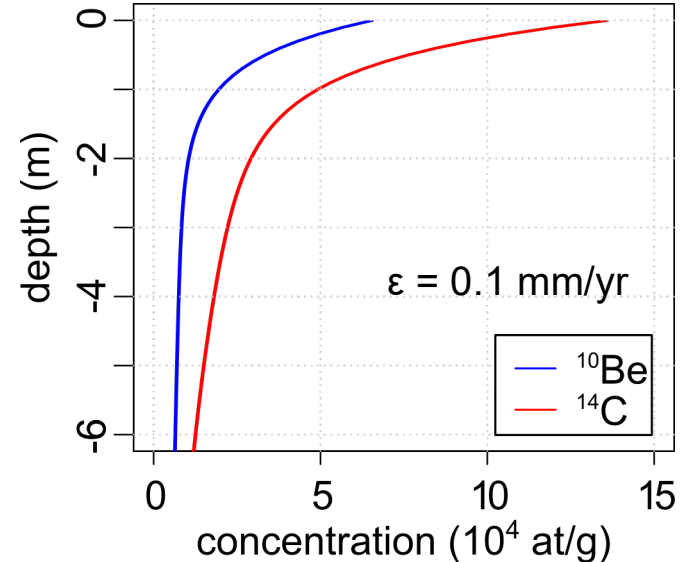
concentration (10^4 at/g)

Impact on concentrations of a test hypothesis of an instantaneous increase of ε
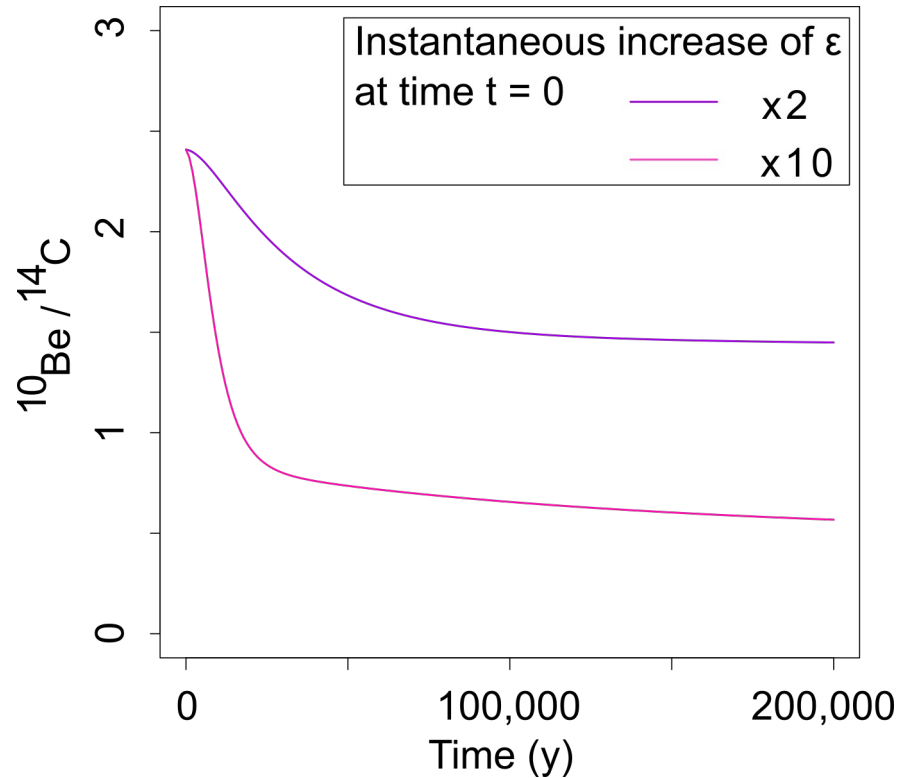
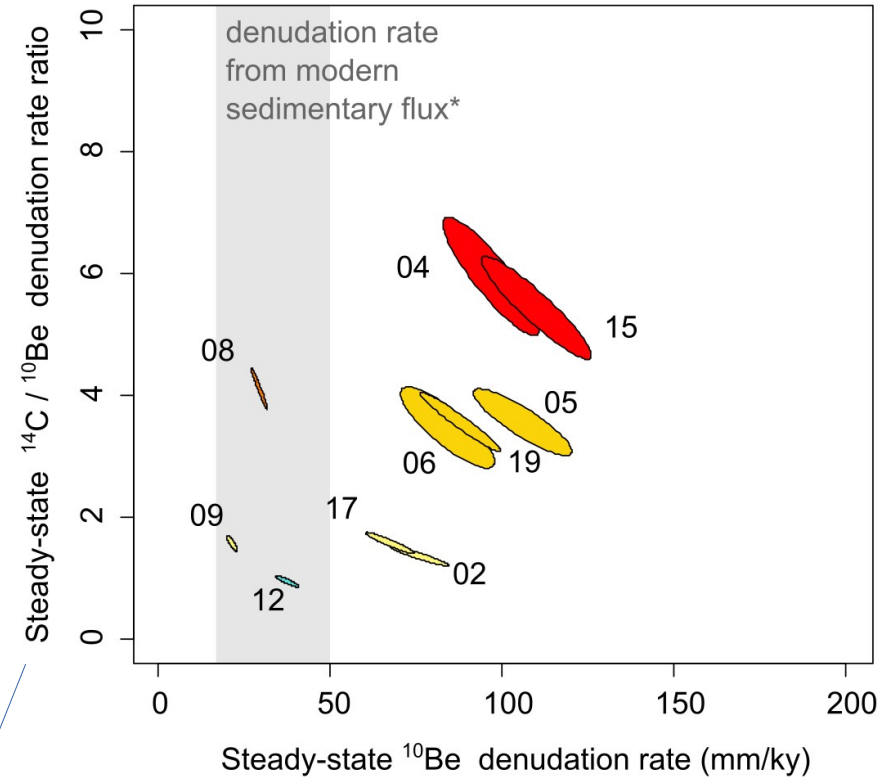With ε_0 = 10 mm/ky, elevation = 1000 m

Correlation between ^{14}C and ^{10}Be concentrations

Measurements at *cerege* **ETH** *zürich*
1-sigma uncertainties
Sample #11 not measured

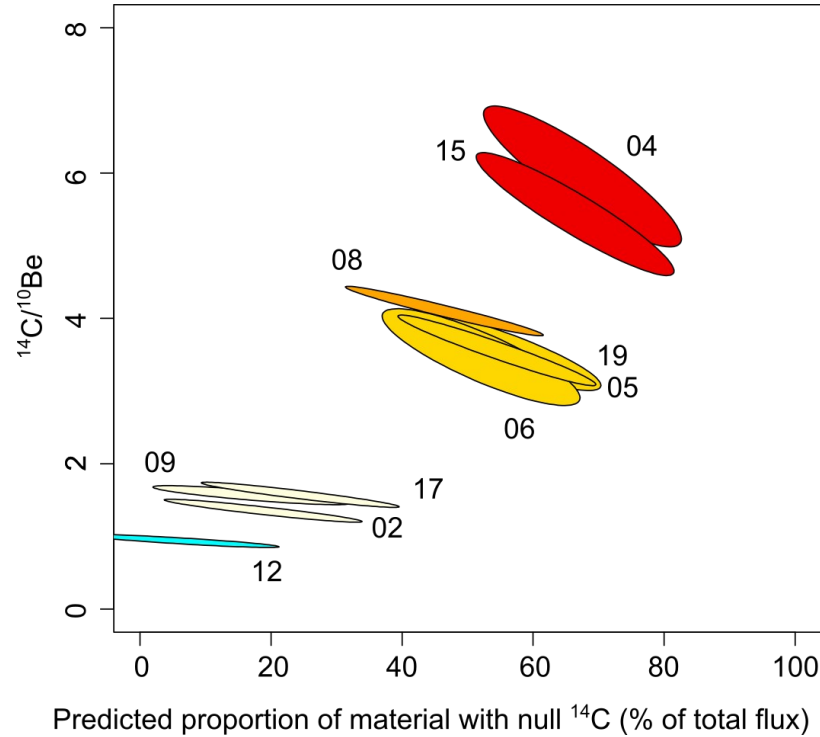Simulation by optimization of each sample and then convergence

► Steady-state ratio abbreviated as «$^{14}C/^{10}Be$» in discussion

^{10}Be denudation rates lag behind ^{14}C denudation rates

Steady-state denudation rates calculated using Balco et al. 2008 online calculator

4

#1: Injection of sediment with no ^{14}C

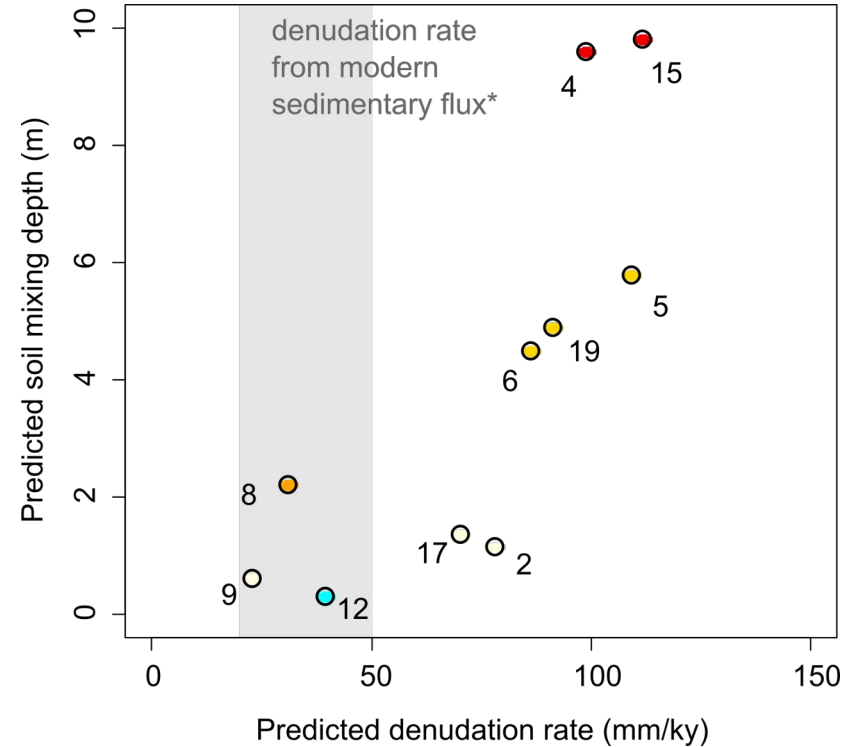**#2: Soil mixing**

Unrealistic, given the few terraces
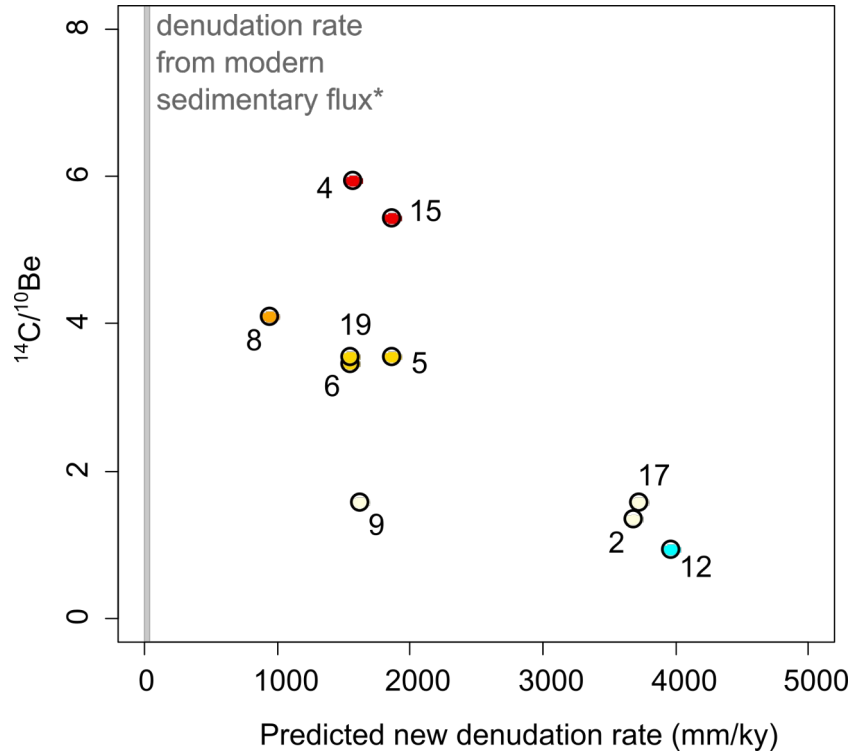and little storage space in catchments

Samples taken individually, 1 sigma

Unrealistic, most soils ≤ 1 m presently
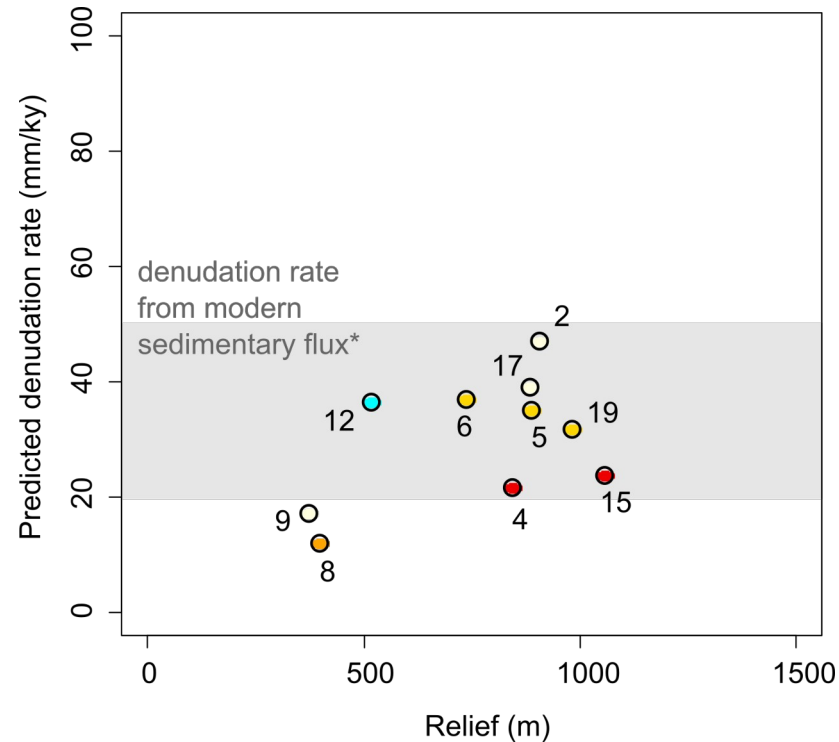And observed correlation is inverse of what is expected

Samples taken individually

#3: 1-step increase of denudation rates

#4: Instantaneous soil removal

Increase should have occurred after 500 A.D.
Increase factor should be ~90
New denudation rates too high for this setting

All samples considered

Soil loss should have occurred after 1700 A.D.
Calculated denudation rates correlate with relief
and are consistent with modern sedimentary flux

All samples considered