Role of low-frequency high-intensity erosive events versus continuous erosion on landscape evolution of the Atacama desert

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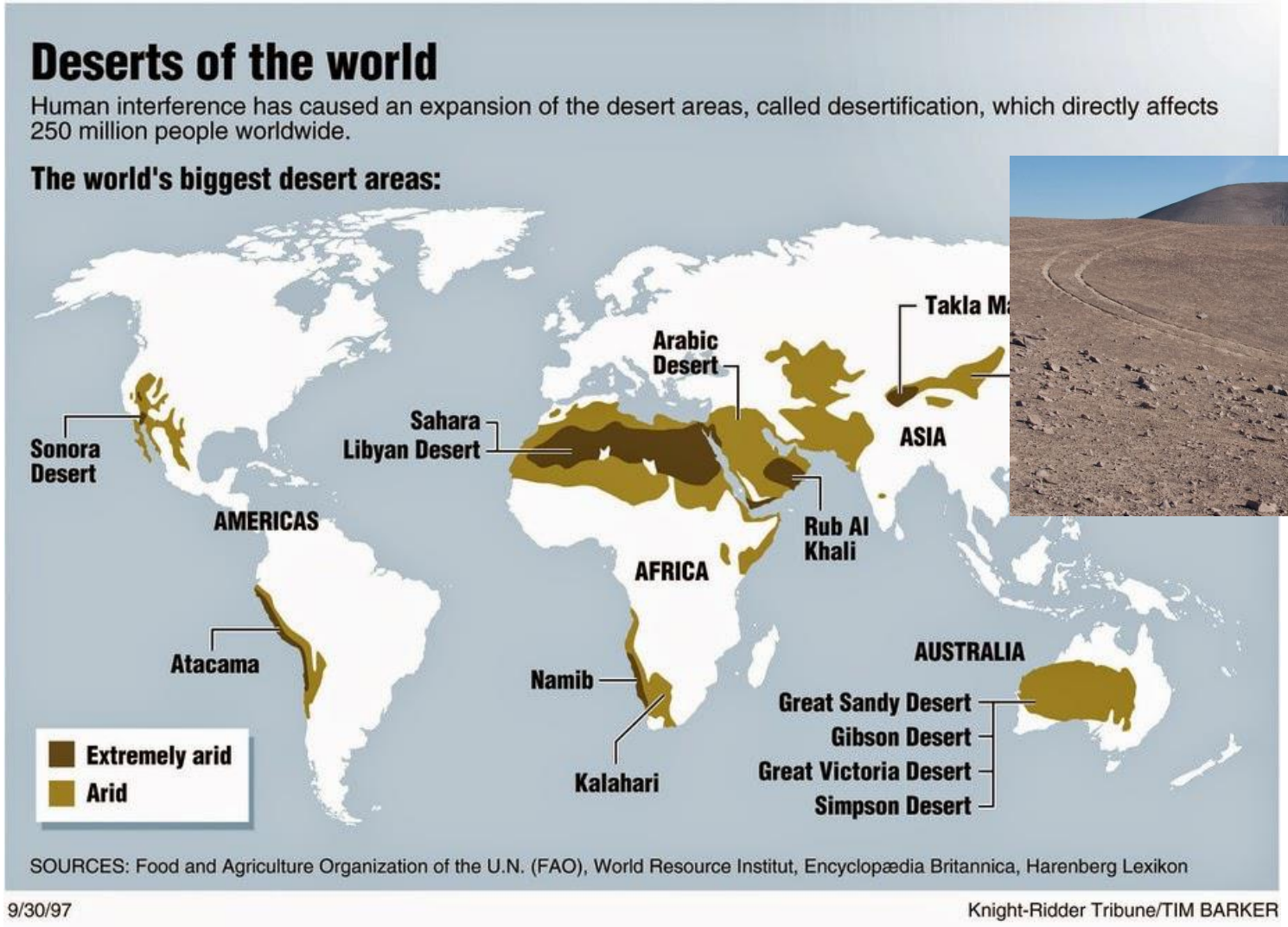
The Atacama Desert

- One of the driest desert on Earth



Extreme rainfall events

SENAMHI
@Senamhiperu

#Aviso Del 21 al 24 de febrero se presentarán lluvia, nieve y granizo en la #sierra centro y sur. ow.ly/LCeP30qjl8D
#ElPerúPrimero

18 17:18 - 20 feb. 2020

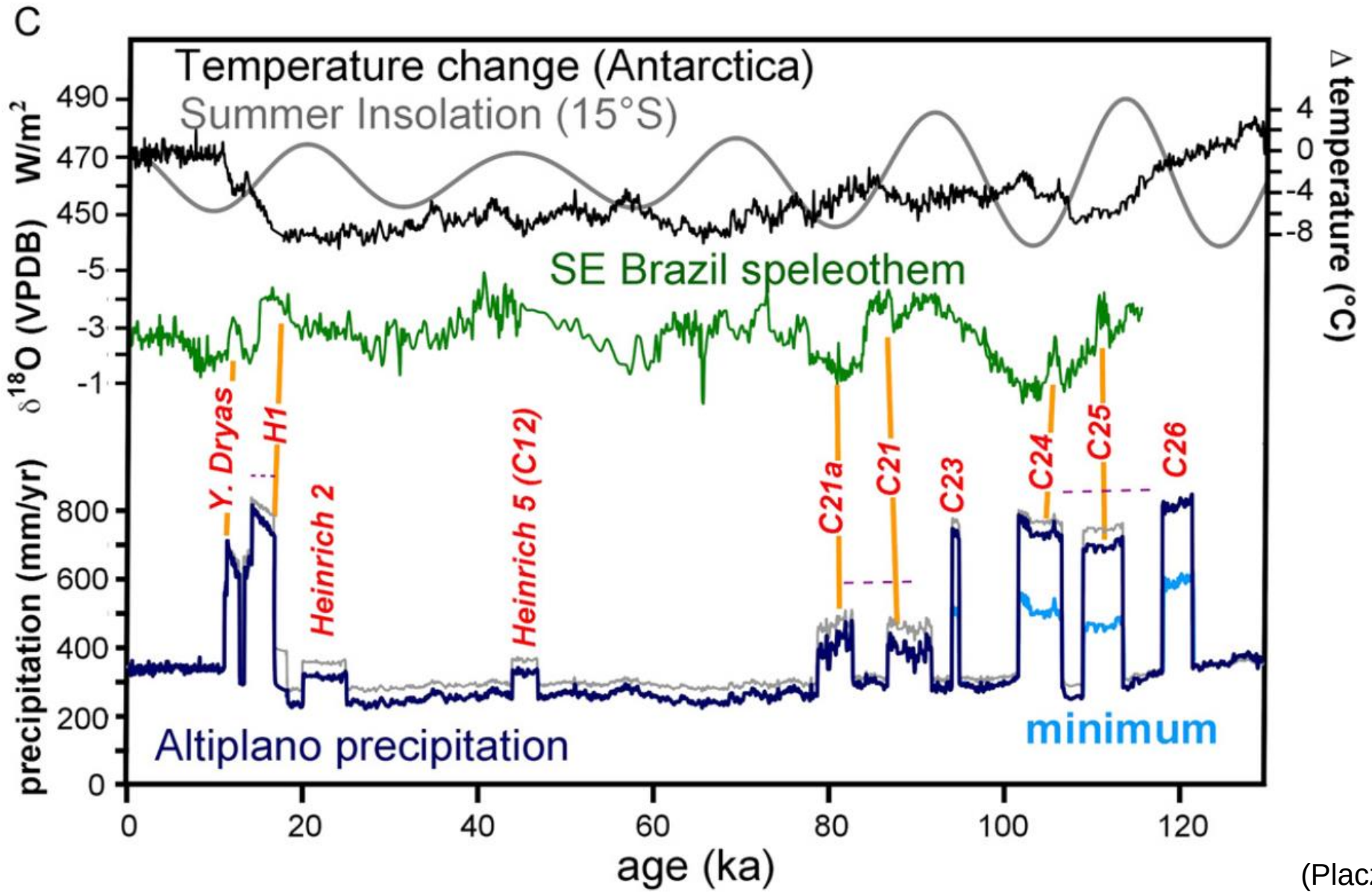
Tacna soportó el viernes un récord histórico de lluvias, según Senamhi (VIDEO)

Meteorólogo del Senamhi precisó que las precipitaciones alcanzaron un valor de 23.8 mm/día. Las lluvias en la región continuarán hasta este domingo.

Actualizado el 22/02/2020 a las 12:29

Al menos cuatro personas perdieron la vida producto de los huaicos que se registraron el viernes tras las intensas precipitaciones en la región Tacna. En ese sentido, el Servicio Nacional de Meteorología e Hidrología del Perú (Senamhi), precisó que los acumulados de lluvias alcanzaron un valor de 23.8 mm/día, un récord histórico para esa zona costera.

Wet periods in South America



(Placzek et al., 2013)

Aim of the study

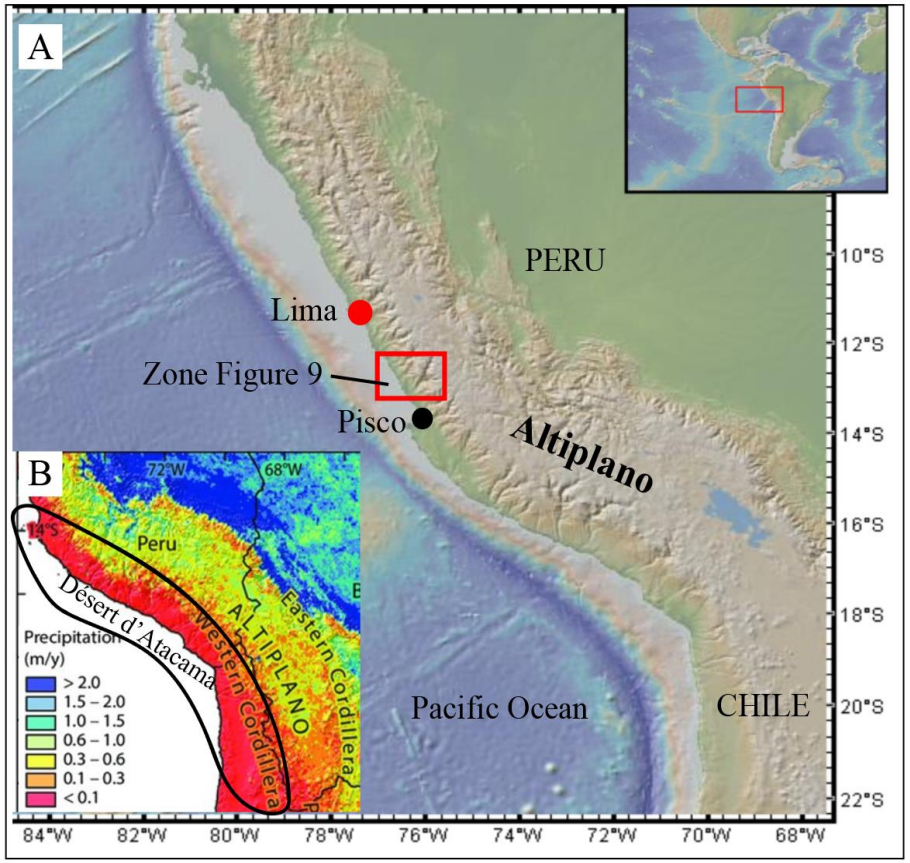
- The relatively low-frequency but high-intensity events seem to play an important role in erosion budgets and in the long-term landscape evolution.

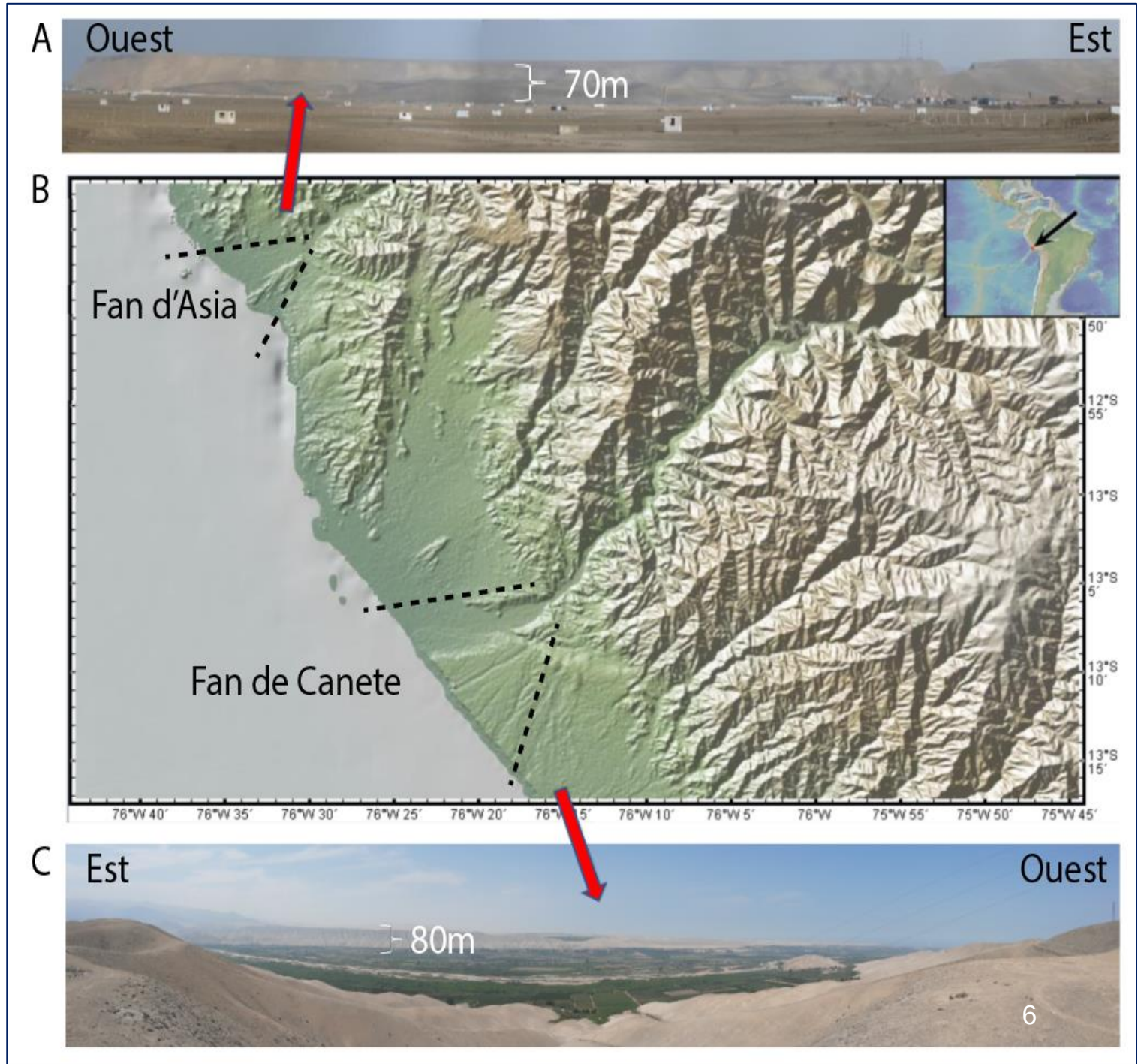
The aim is to understand the respective role of :

long-term/continuous erosion vs extreme and rare events

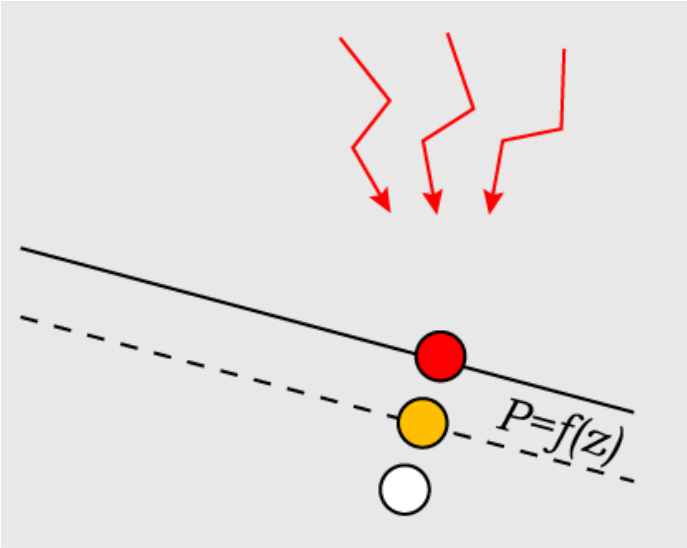
in the erosional processes and on landscape evolution in the Atacama Desert

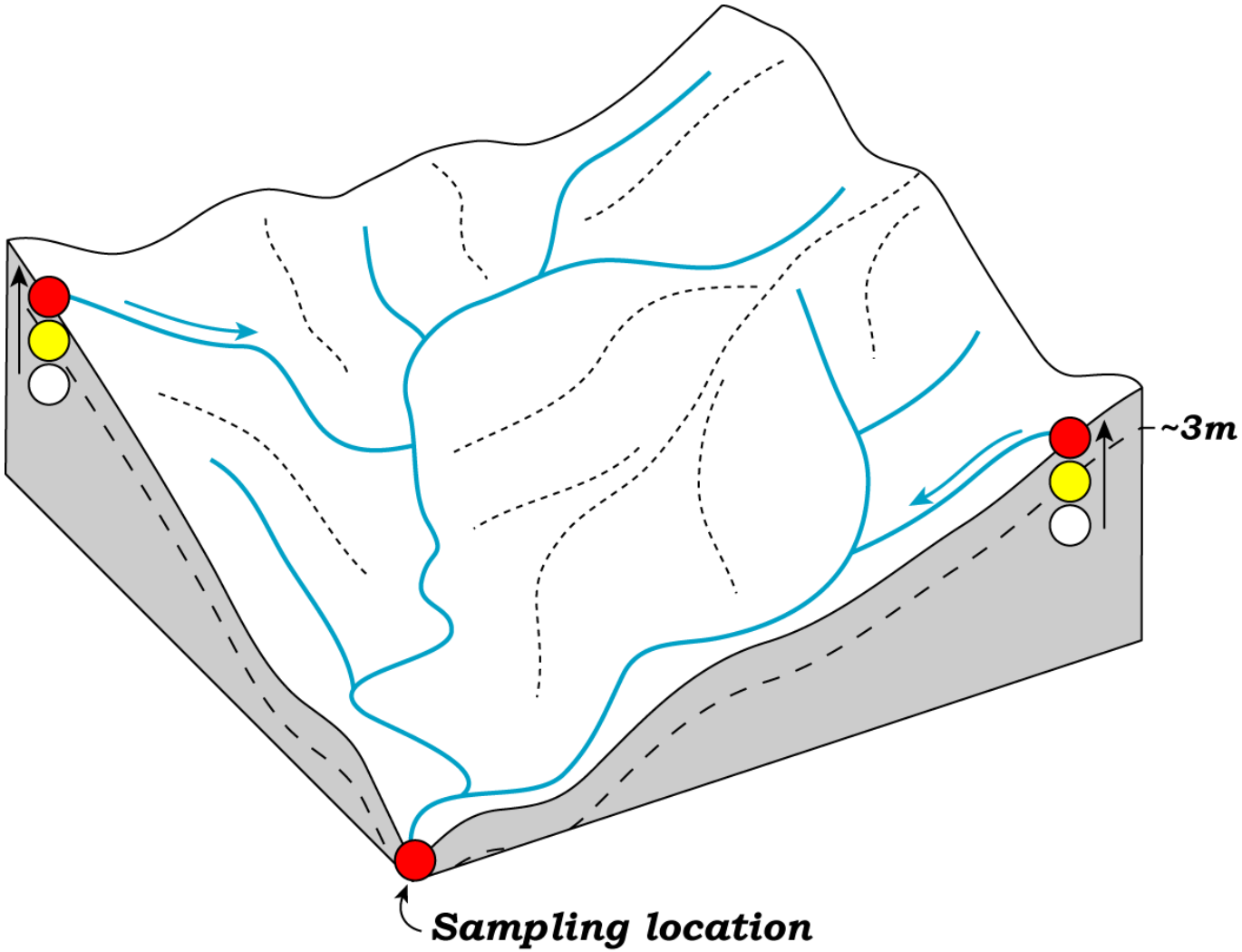
Study site


A
PERU
Lima
Zone Figure 9
Pisco
Altiplano
B
72°W
68°W
14°S
Peru
Désert d'Atacama
Western Cordillera
ALTIPLANO
Eastern Cordillera
Precipitation (m/y)
> 2.0
1.5 – 2.0
1.0 – 1.5
0.6 – 1.0
0.3 – 0.6
0.1 – 0.3
< 0.1
Pacific Ocean
CHILE
10°S
12°S
14°S
16°S
18°S
20°S
22°S
84°W
82°W
80°W
78°W
76°W
74°W
72°W
70°W
68°W

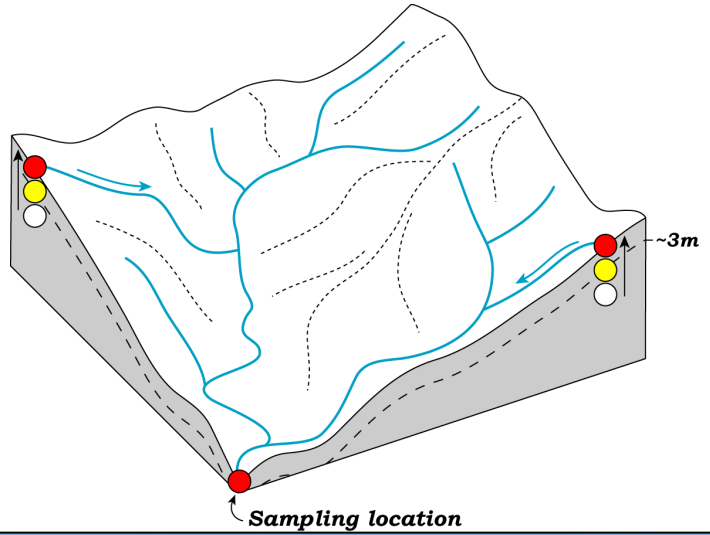

A
Ouest
Est
70m
B
Fan d'Asia
Fan de Canete
50'
12°S 55'
13°S
13°S 5'
13°S 10'
13°S 15'
76°W 40'
76°W 35'
76°W 30'
76°W 25'
76°W 20'
76°W 10'
76°W 5'
76°W
75°W 55'
75°W 50'
75°W 45'
C
Est
Ouest
80m

Cosmogenic nuclides concentration





Paleo concentrations



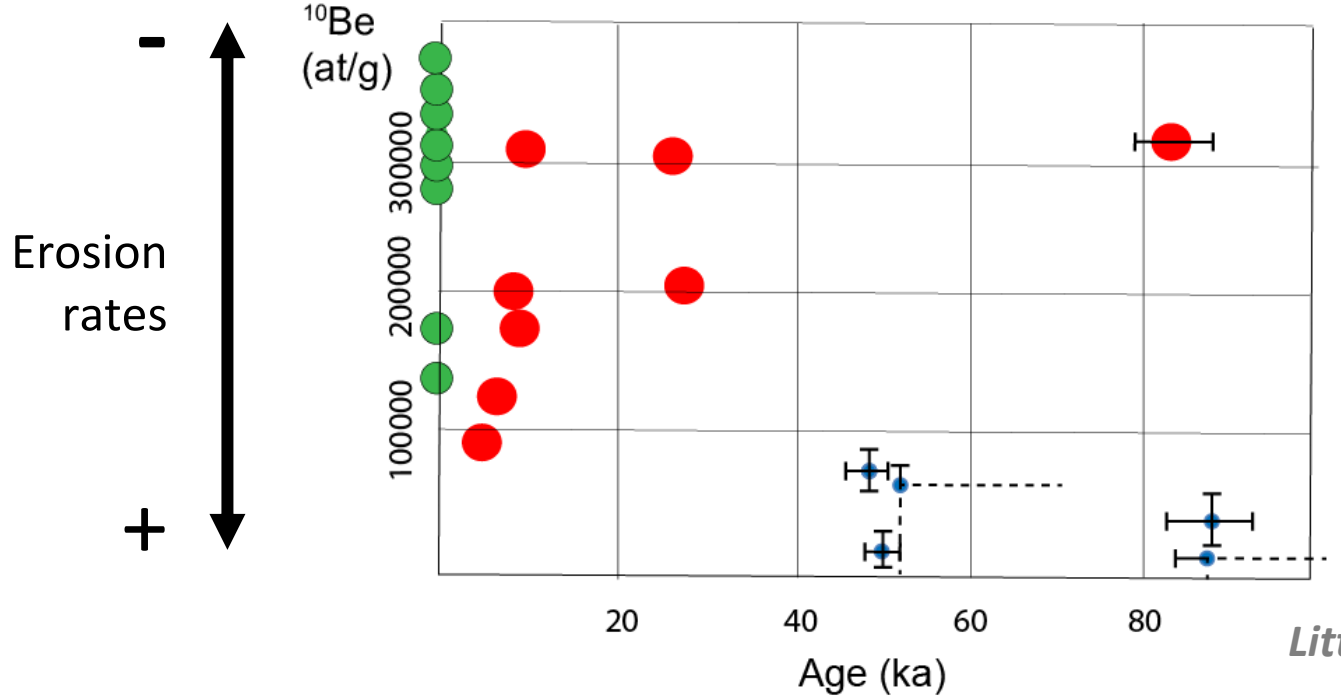
- Require the age of deposition of the sedimentary archive
  - to correct for loss of atoms due to the radioactive decay
  - to obtain the chronology of the erosive events
    - OSL dating
    - ^{14}C in roots

Results

Modern river

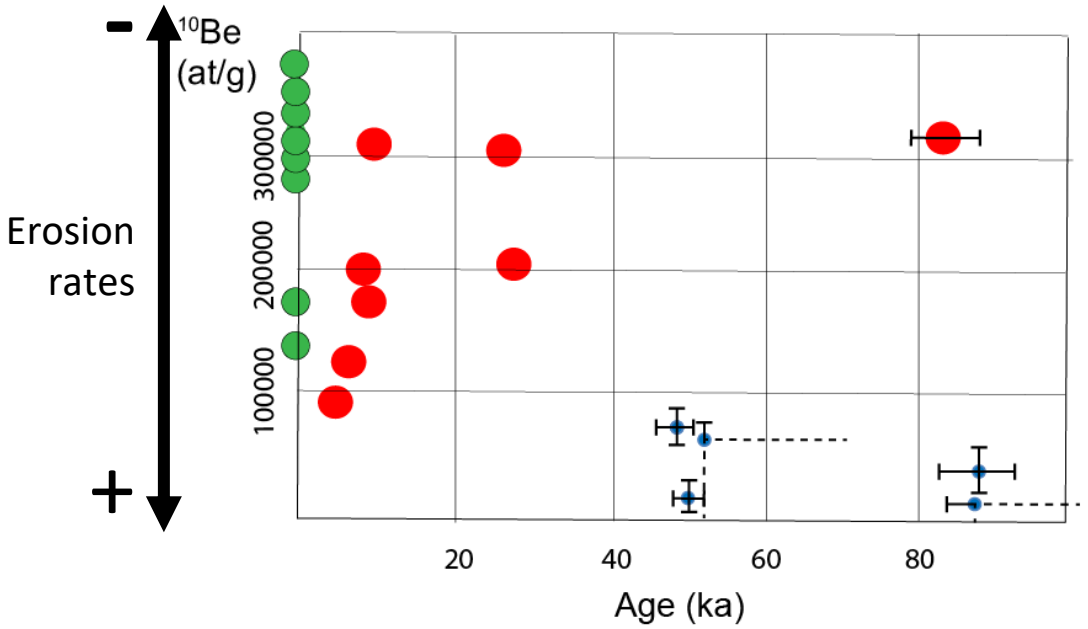
Debris flow deposits

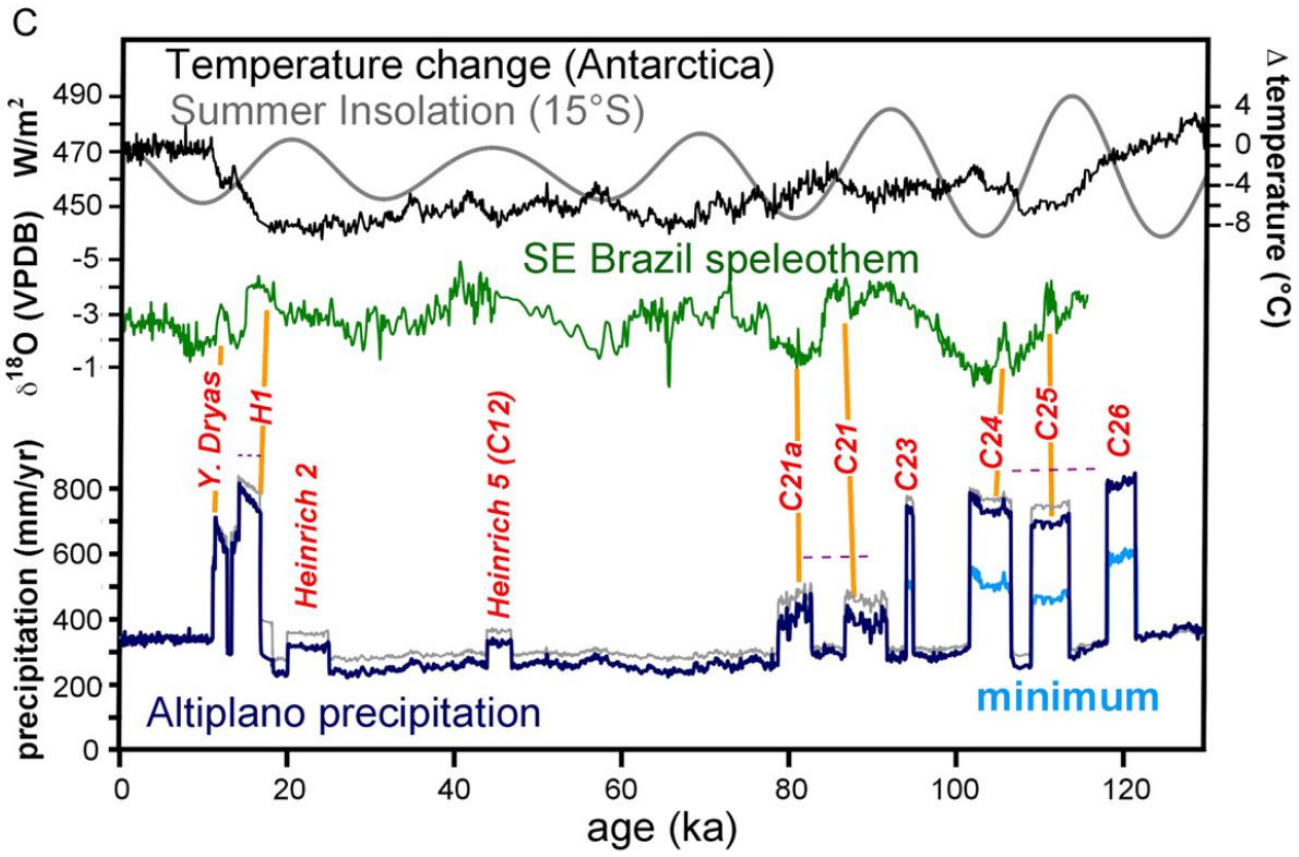
Conglomeratic deposits



***Litty** et al., in prep*

Conglomeratic deposits





Lower concentrations corresponding to wet periods characterized by higher precipitation

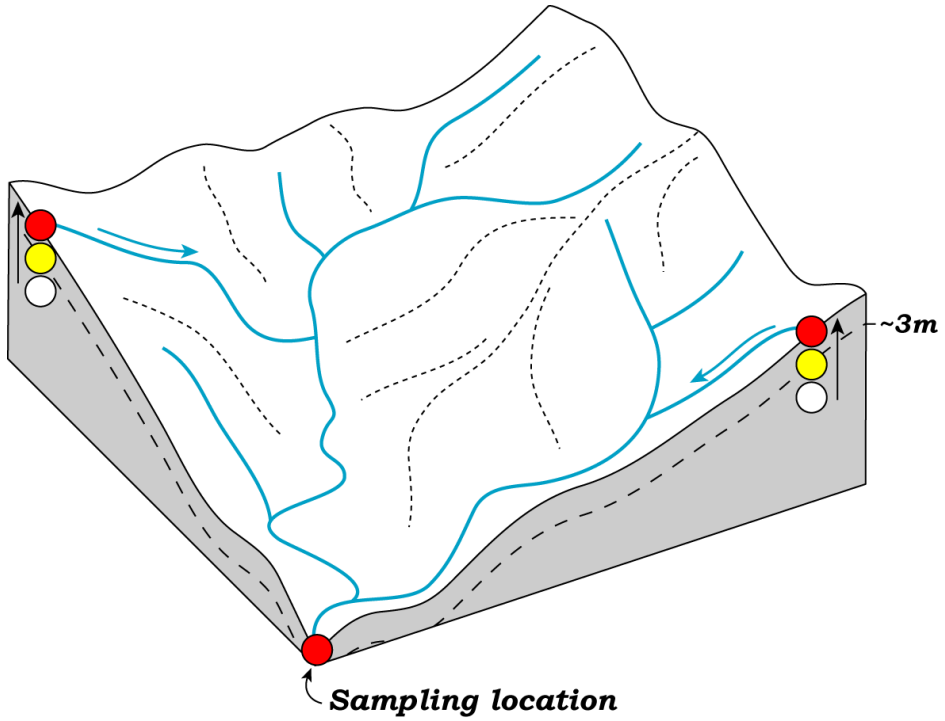
Debris flows

Difficulties to transform concentrations into erosion rates : Material that originated from restrictive areas, therefore not averaging the all catchment

Relatively high concentrations :

- Deposits with **material that sitted on the hillslopes for long time** : integrated time ~16 ka

- Superficial erosion



Conclusions

3 erosive modes:

- Modern river deposits = Dry conditions, background signal

- Debris flow deposits = Dry conditions with intense events similar to El Nino

  Low-frequency but high-intensity events dominate the landscape evolution during the dry phases

- Conglomeratic deposits = long lasting wet conditions (integrating time 3-4 ka)

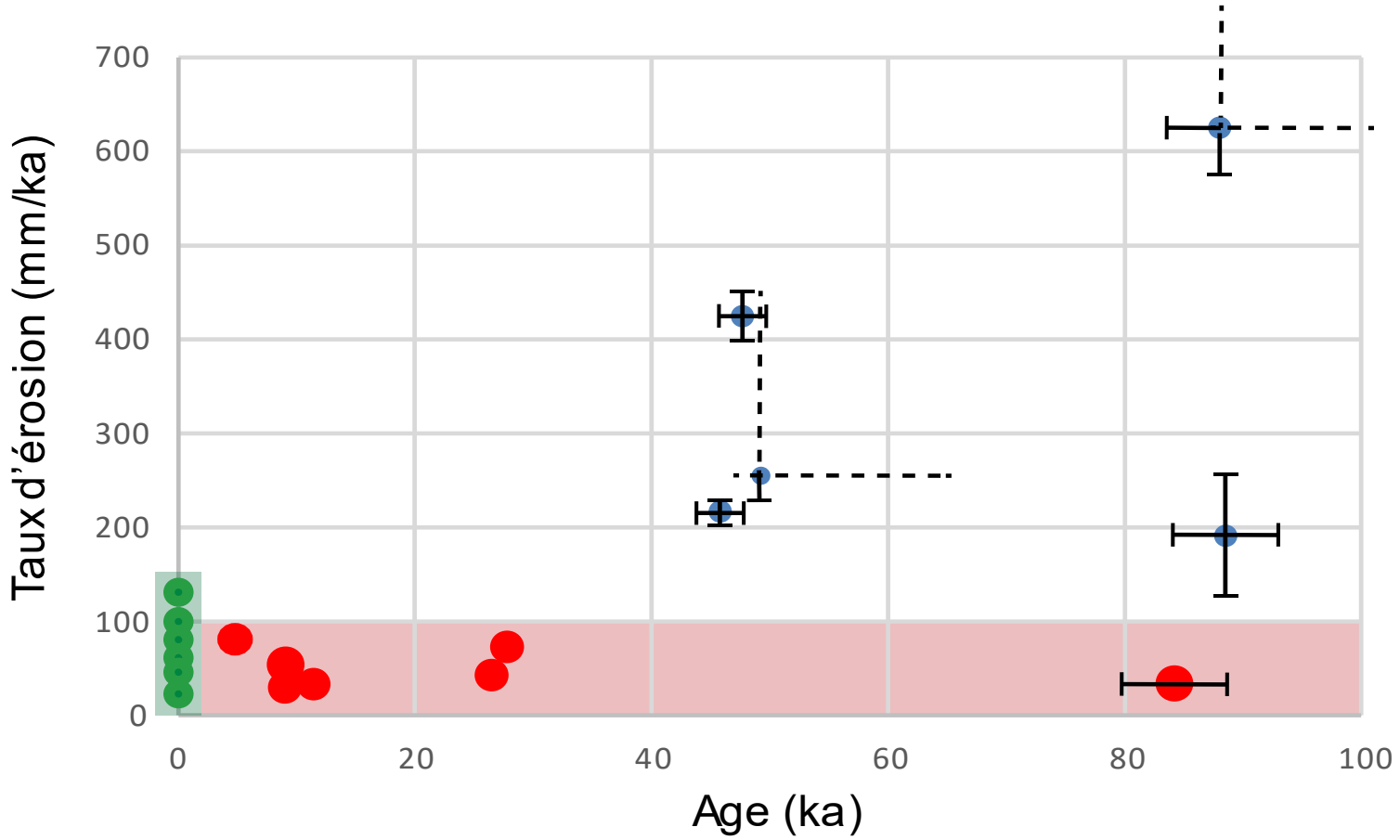
  Fluvial processes dominate the landscape evolution during the wet phases

Thank you

If you have any questions email me at

camille.litty@univ-grenoble-alpes.fr

Erosion rates



- Taux d'érosion mesurés dans les rivières actuelles (Abbuhl et al., 2011; Carretier et al., 2015; Reuter, et al., 2017)
- Paléo taux d'érosion mesurés dans des dépôts types "debris flow" (Bekaddour et al., 2014 + en préparation)
- Paléo taux d'érosion mesurés dans des dépôts conglomératiques (en préparation)