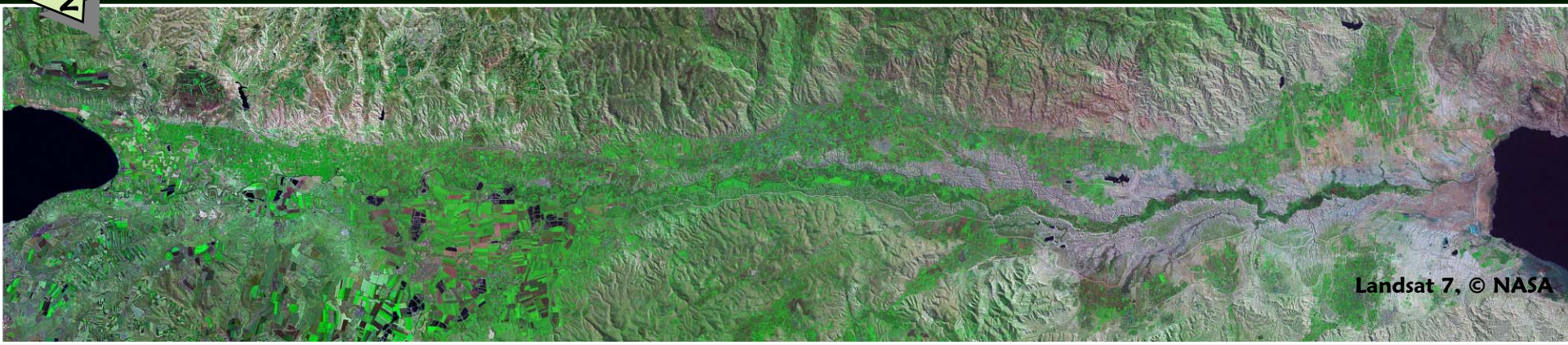
The behavior of continental active faults: Data and models

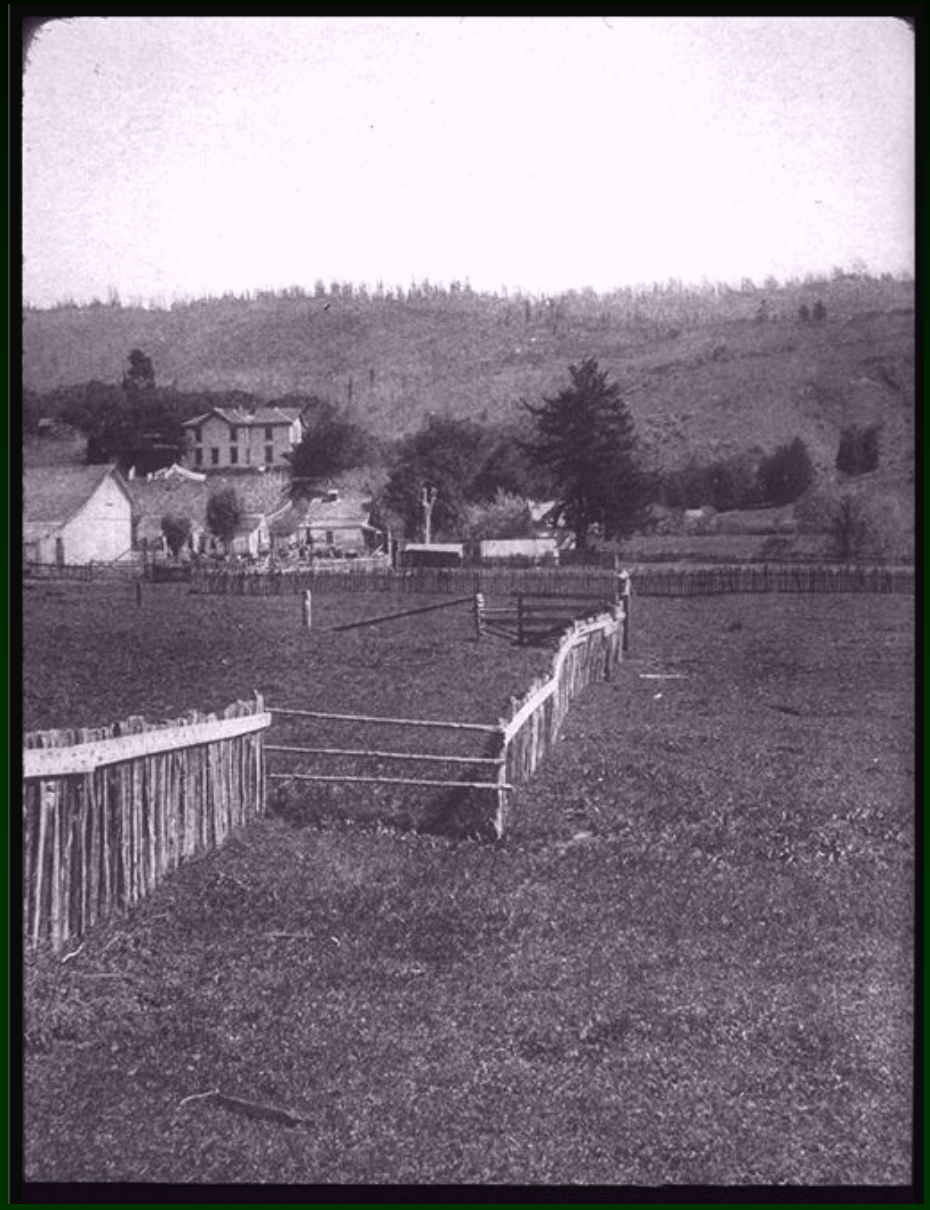


Matthieu Ferry

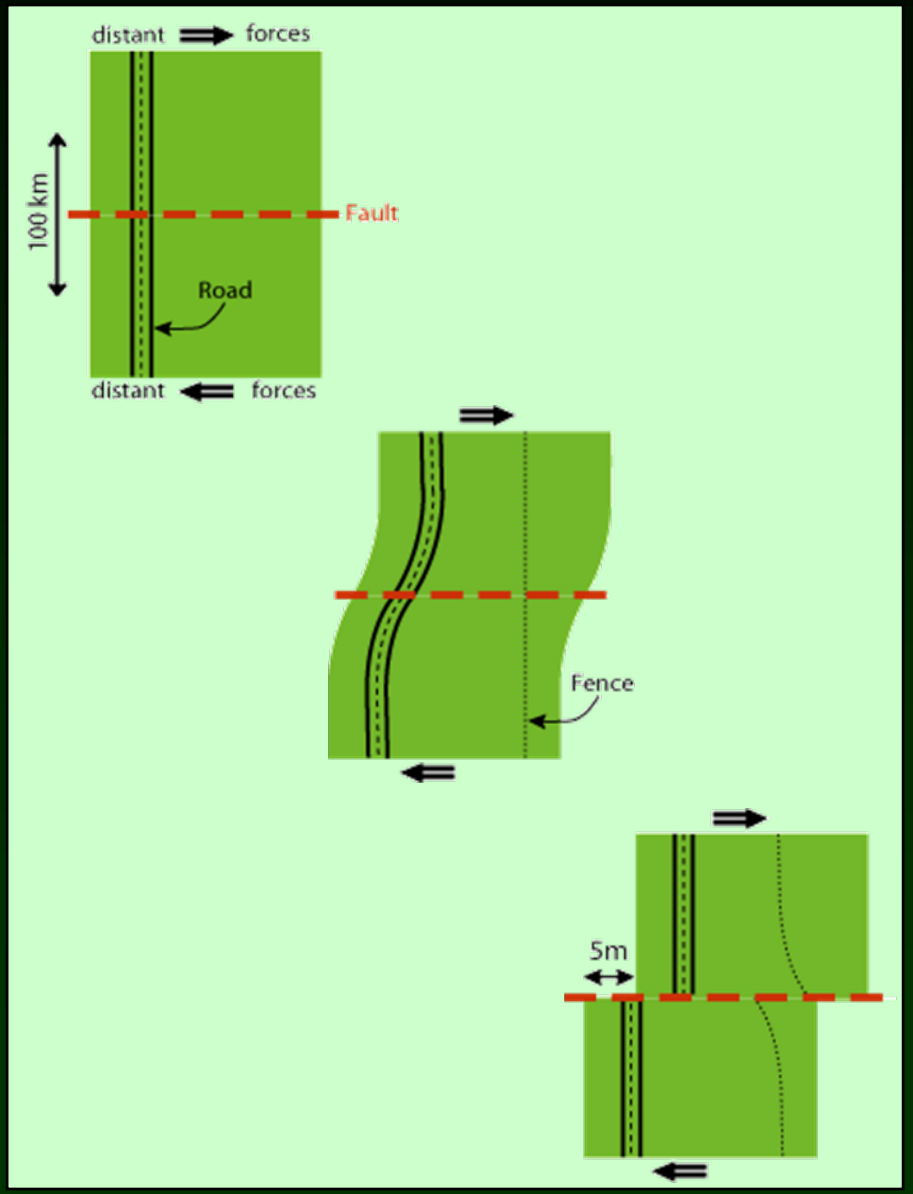
matthieu@uevora.pt

New Perspectives Workshop, CGE, Evora, 4 June 2008

Elastic rebound

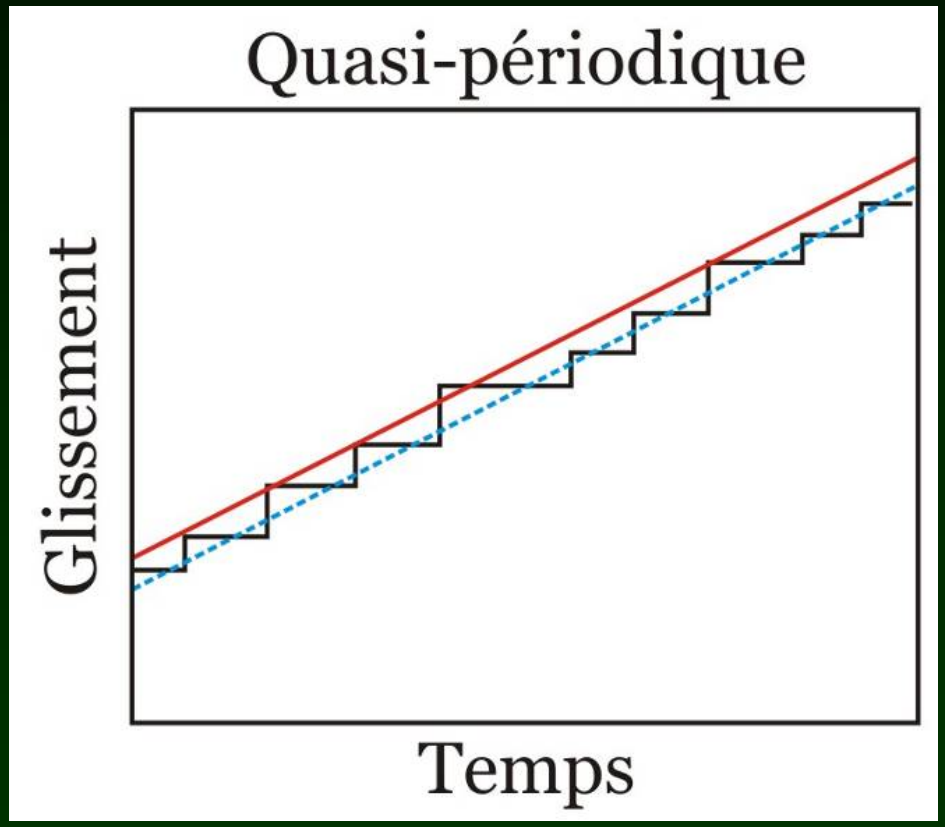


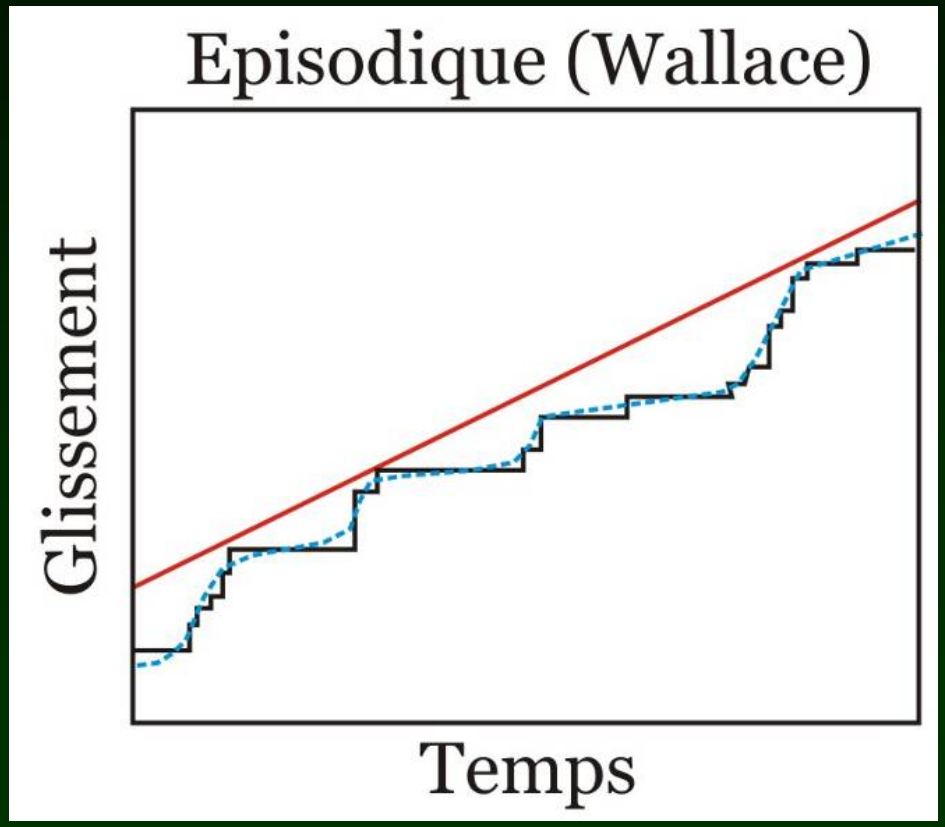
San Francisco 1906, photo G. K. Gilbert



Reid, 1910

Temporal variations





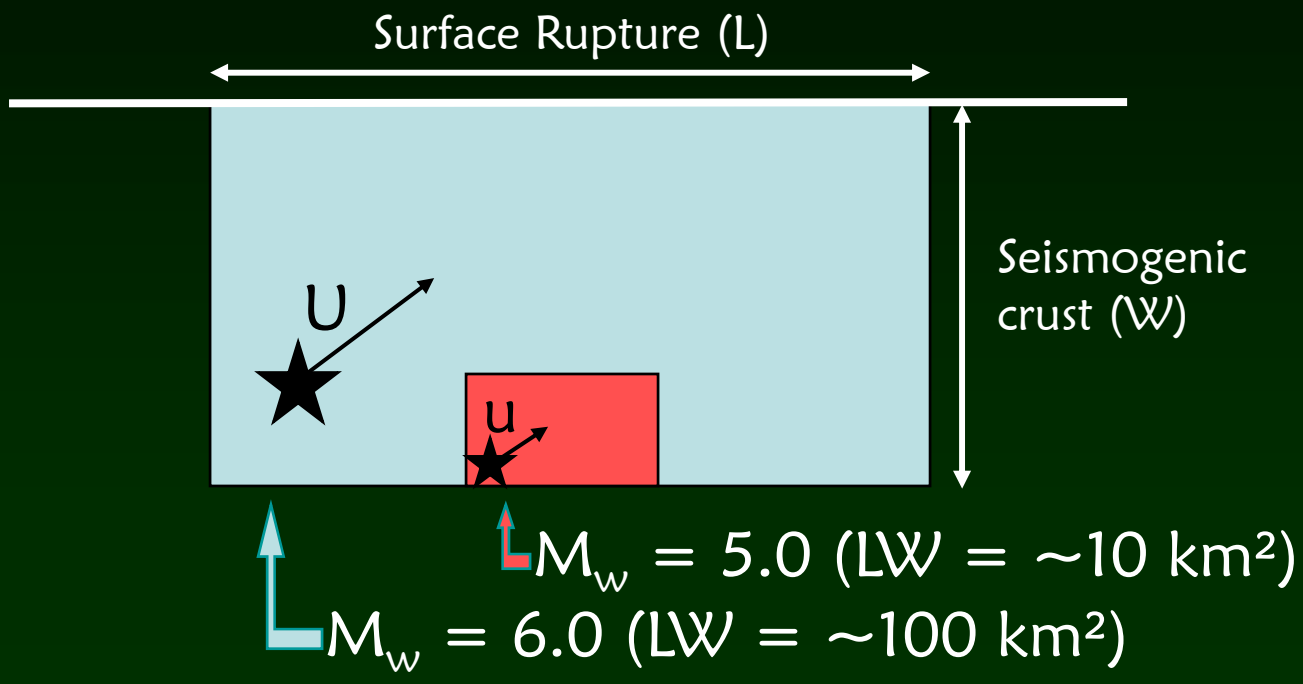
Shimazaki and Nakata, 1980

The « Fault » object

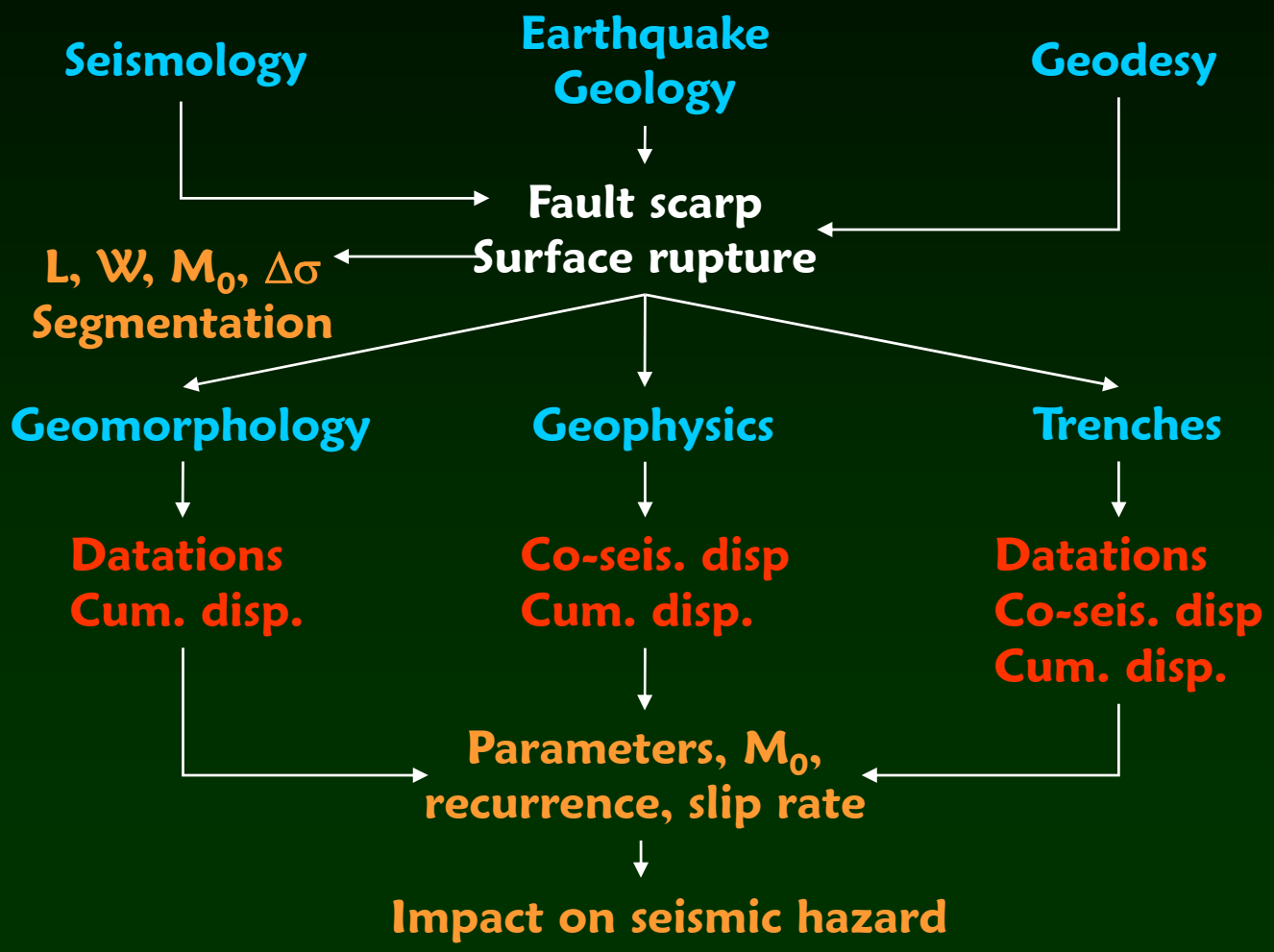
Izmit earthquake, Mw 7.3, 17.08.1999

Photos A. Barka

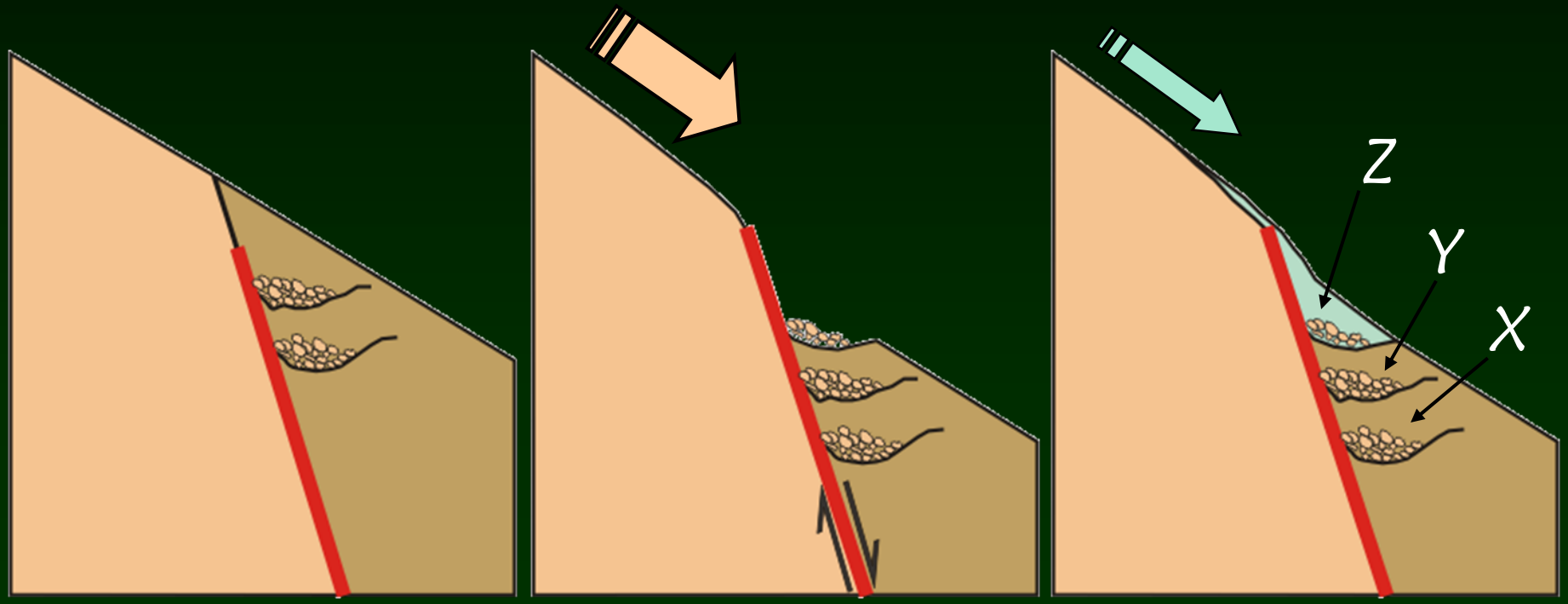
Fault parameters



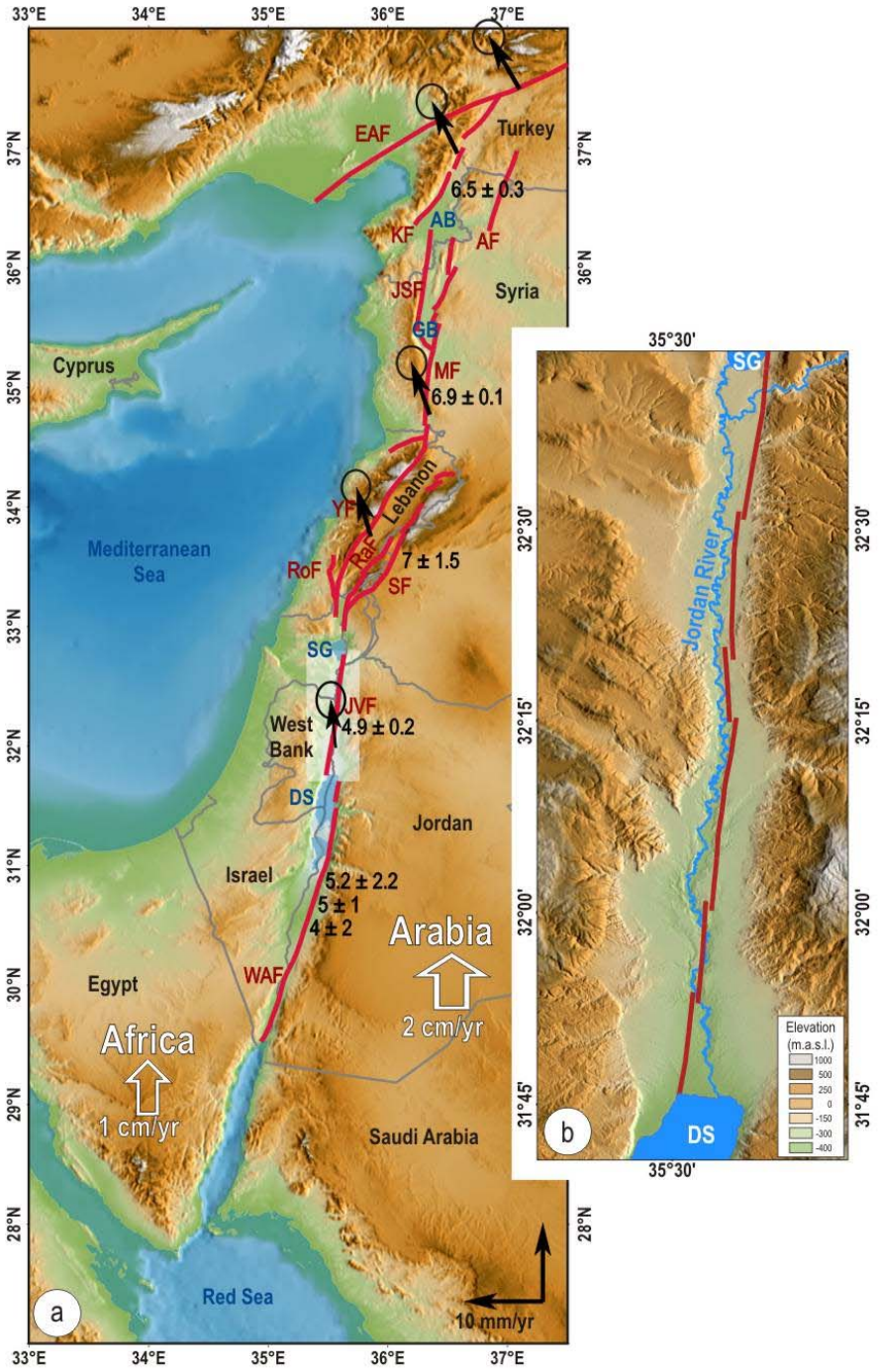
Integrated paleoseismological approach



Sedimentary record of surface ruptures

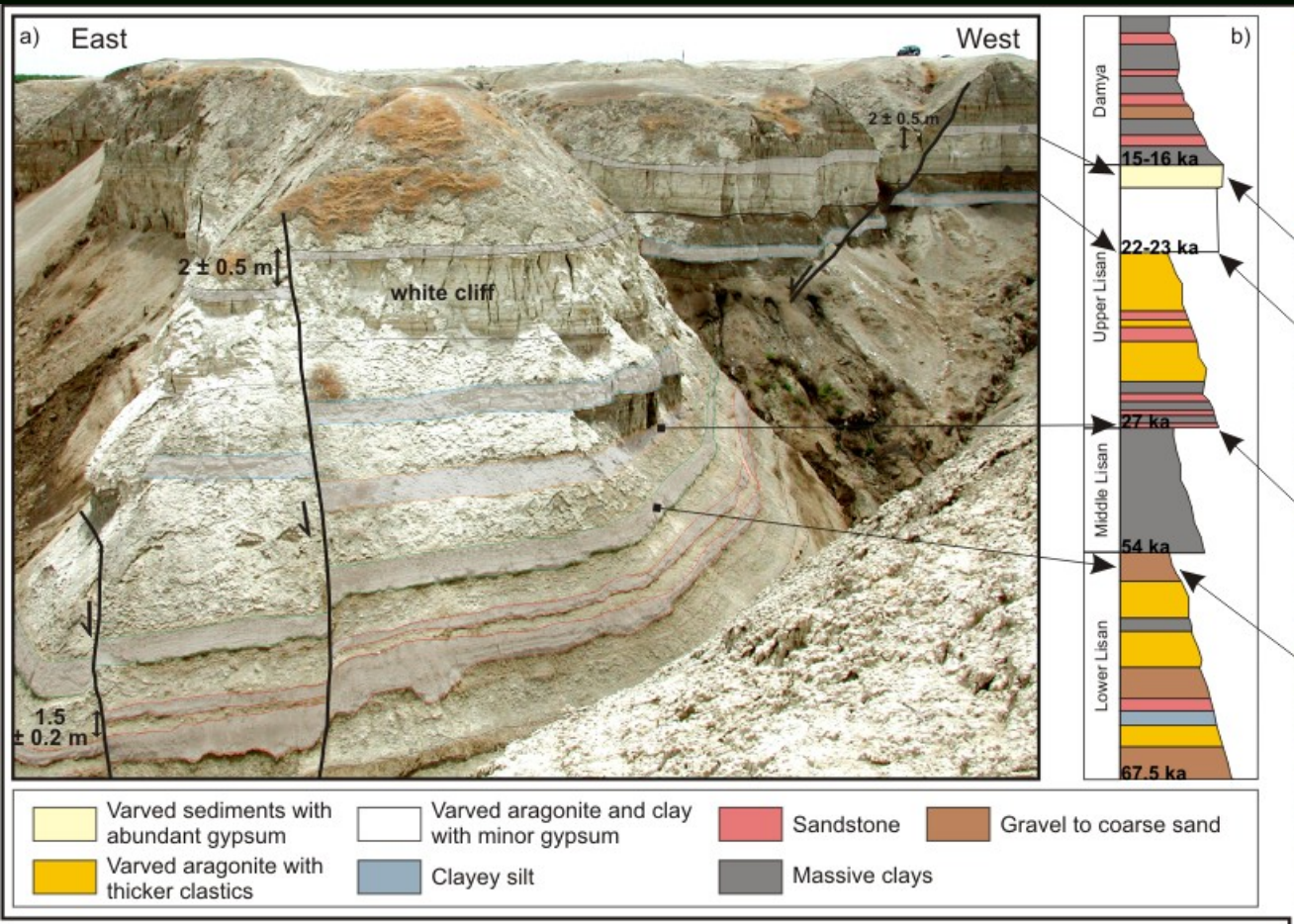


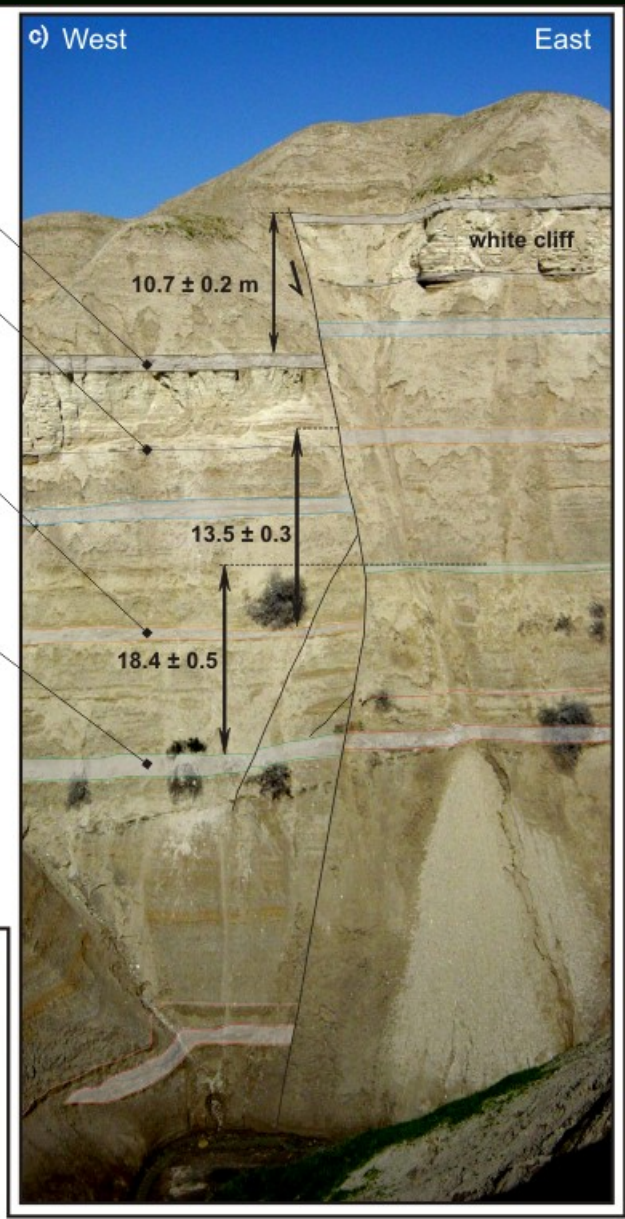
The Dead Sea Fault



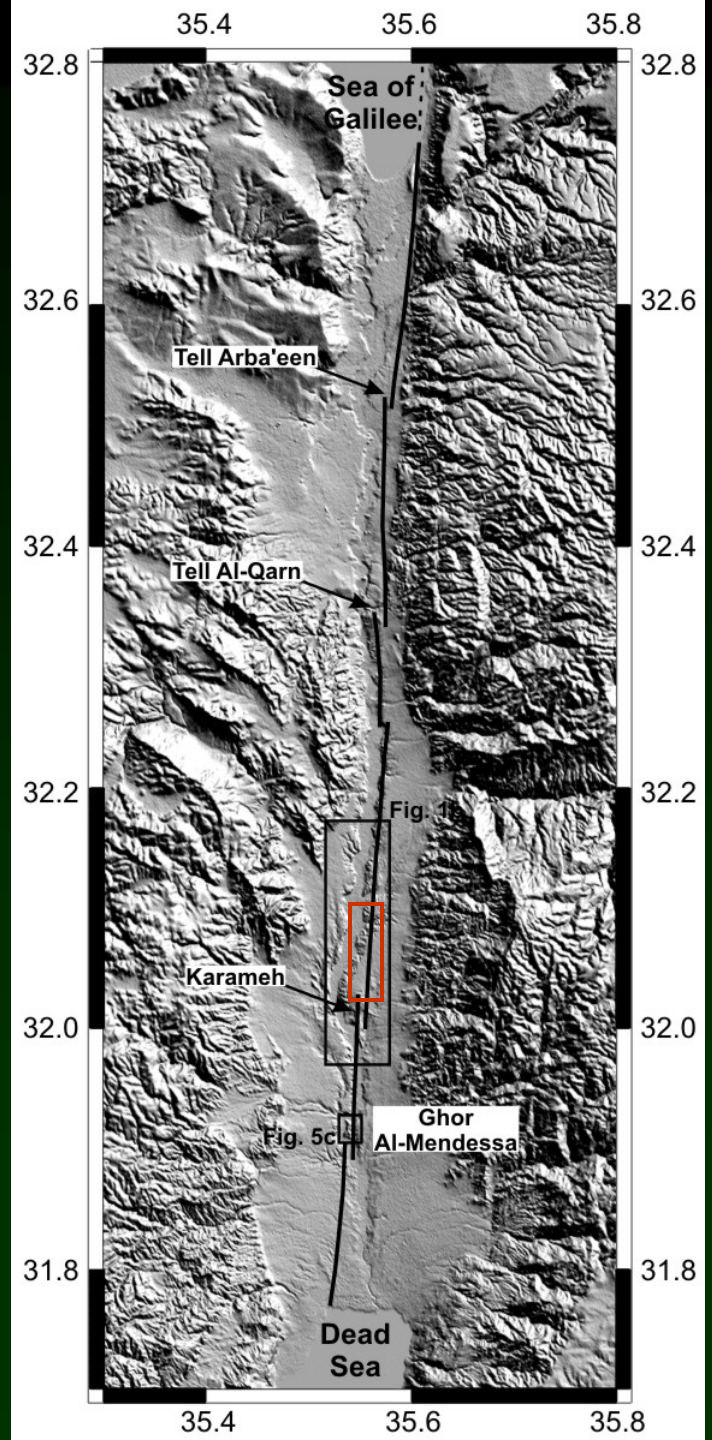
- Transform fault
- ~ 1000 km long
- 2 - 10 mm/yr, left-lateral
- Localised deformation

Fault outcrops in Lisan units





Segmentation of the JVF



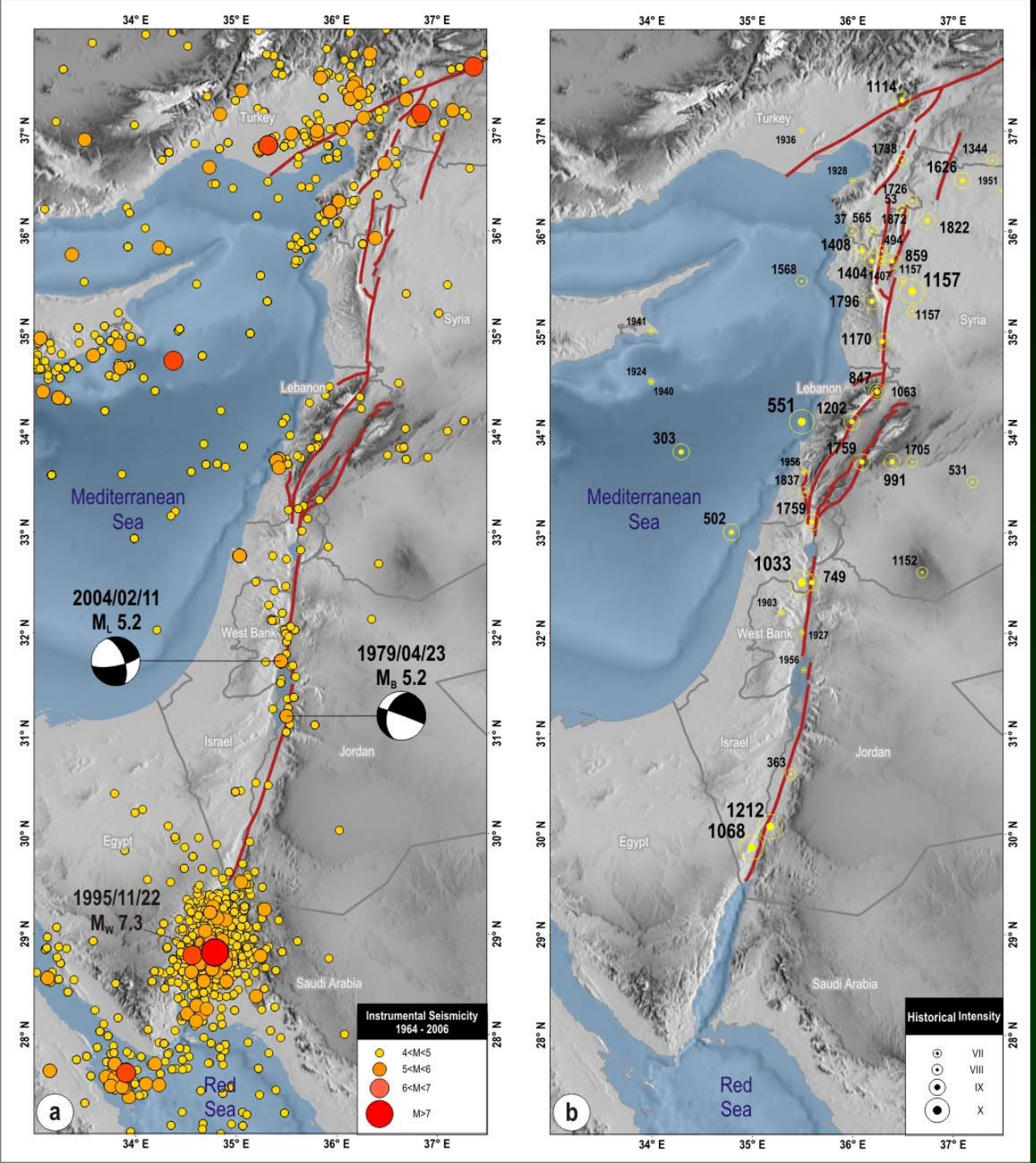
- Comp. stepover: 2 – 3 km
- Ext. stepover: ~ 500 m

→Full-length rupture into M_w 7.2+ events

Ferry et al., 2007, EPSL

Integrated seismicity catalogue

Instrumental, historical, archeoseismicity and paleoseismicity



Seismicity

Instrumental

- Low

- Localised

Historical

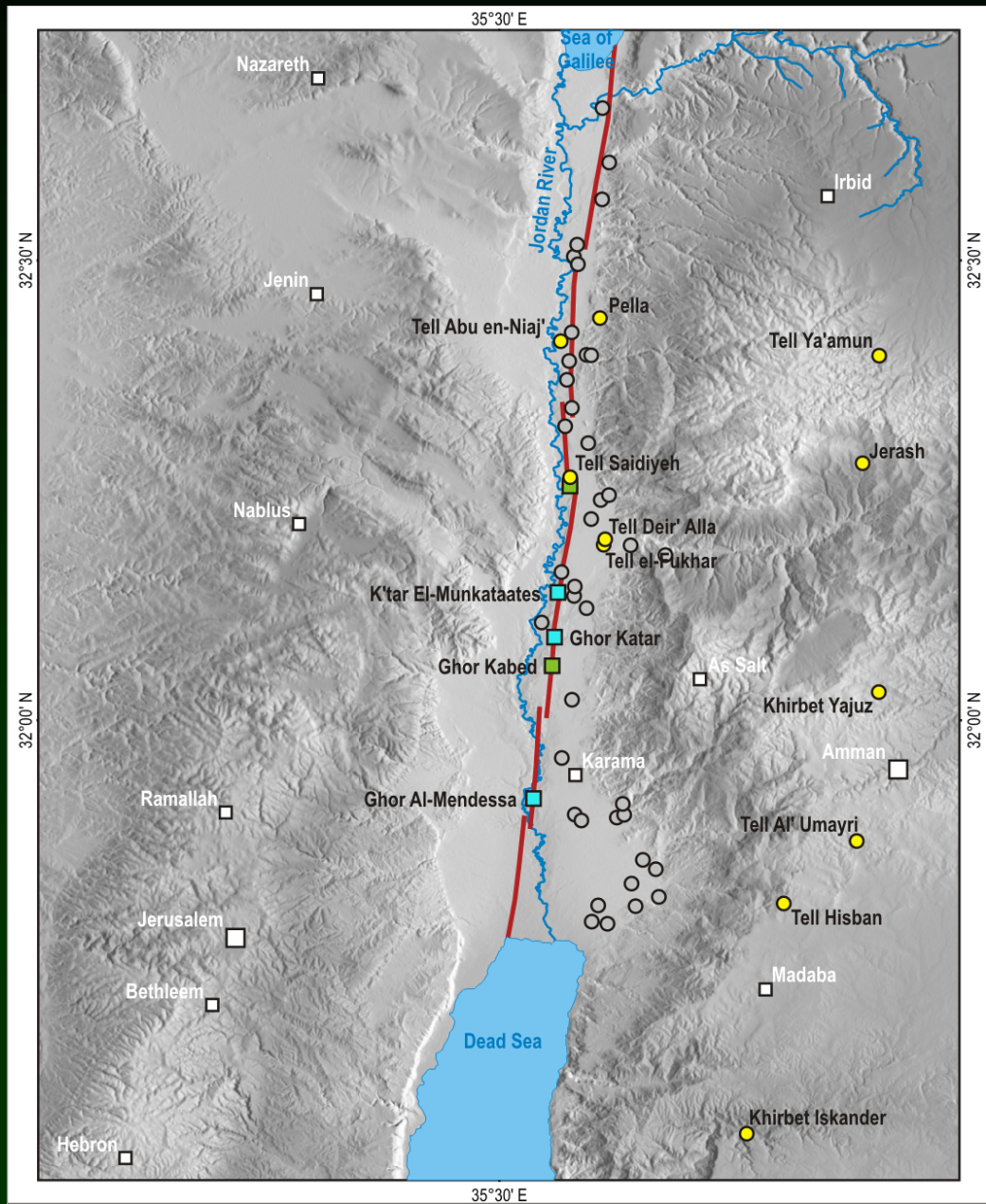
- 31 BC

- AD 749

- AD 1033

Archeoseismology of the JVF

- Since 20'000 BC
- More than 120 sites
- Well distributed
- Numerous sites **on** the fault

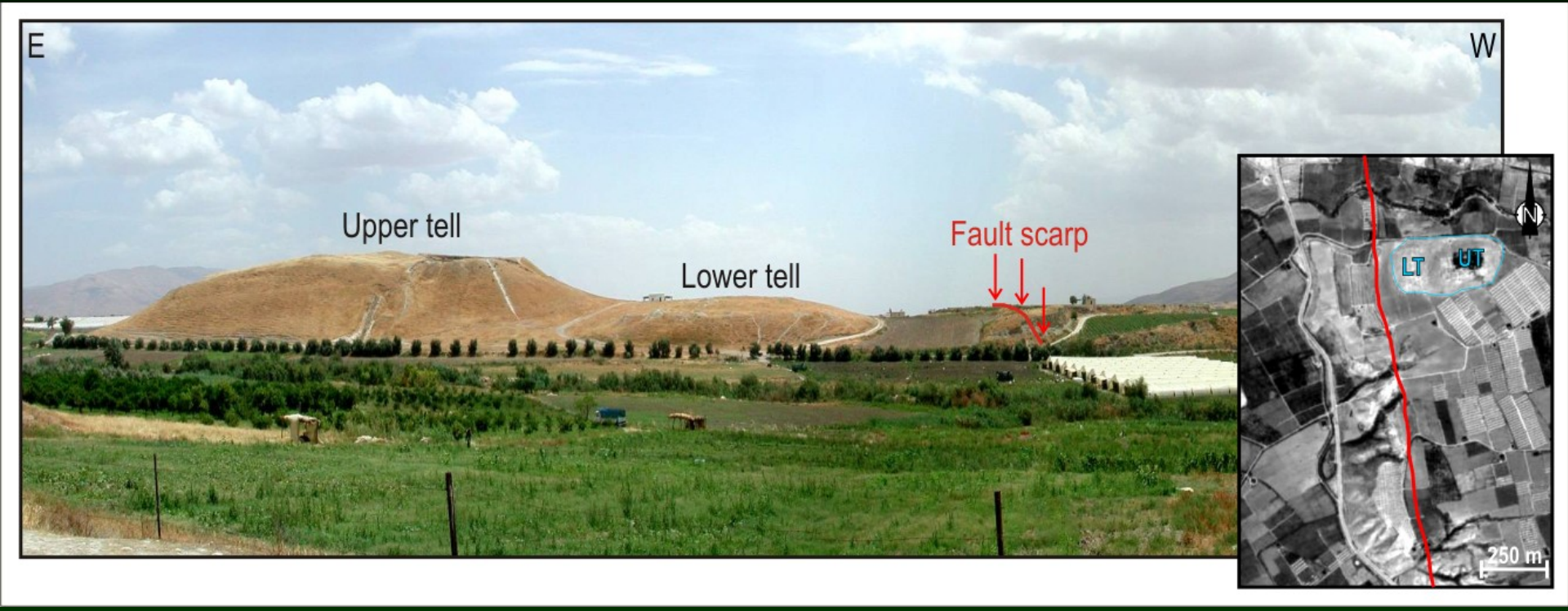


Earthquakes and cultural heritage in Jordan

Jerash (AD 749)

Petra (AD 363)

Archeoseismology of Tell Saydiyeh I



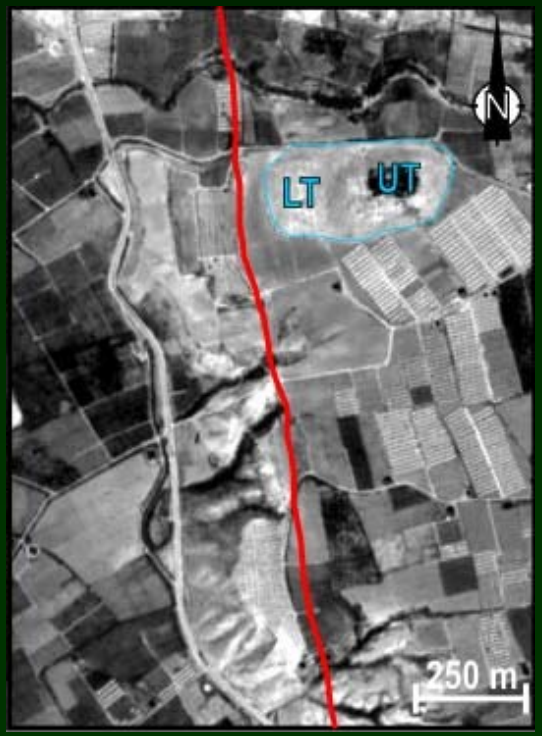
Archeoseismology of Tell Saydiyeh II

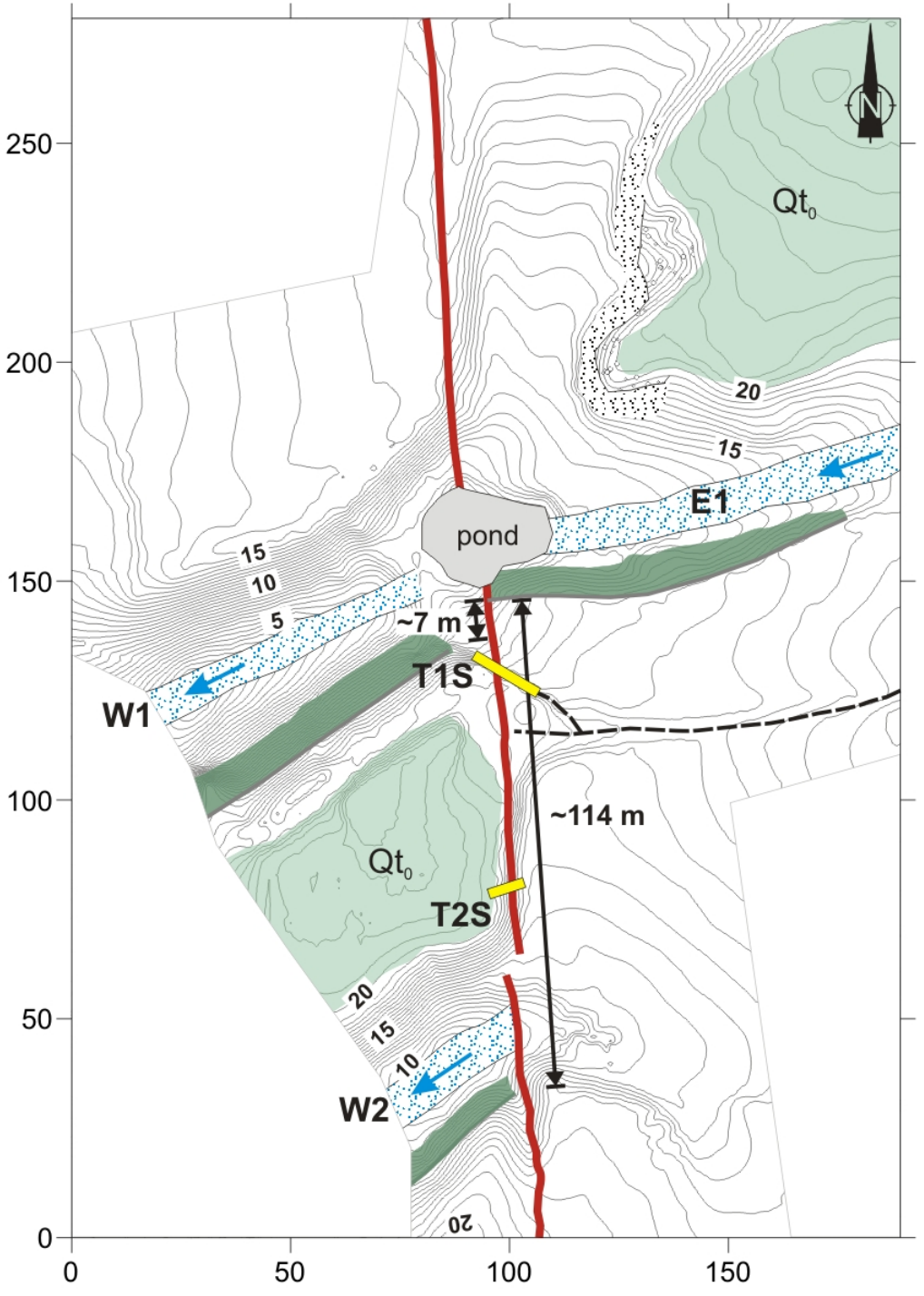
Tubb, 1988
Tubb, 1998

Geomorphology of Tell Saidiyeh

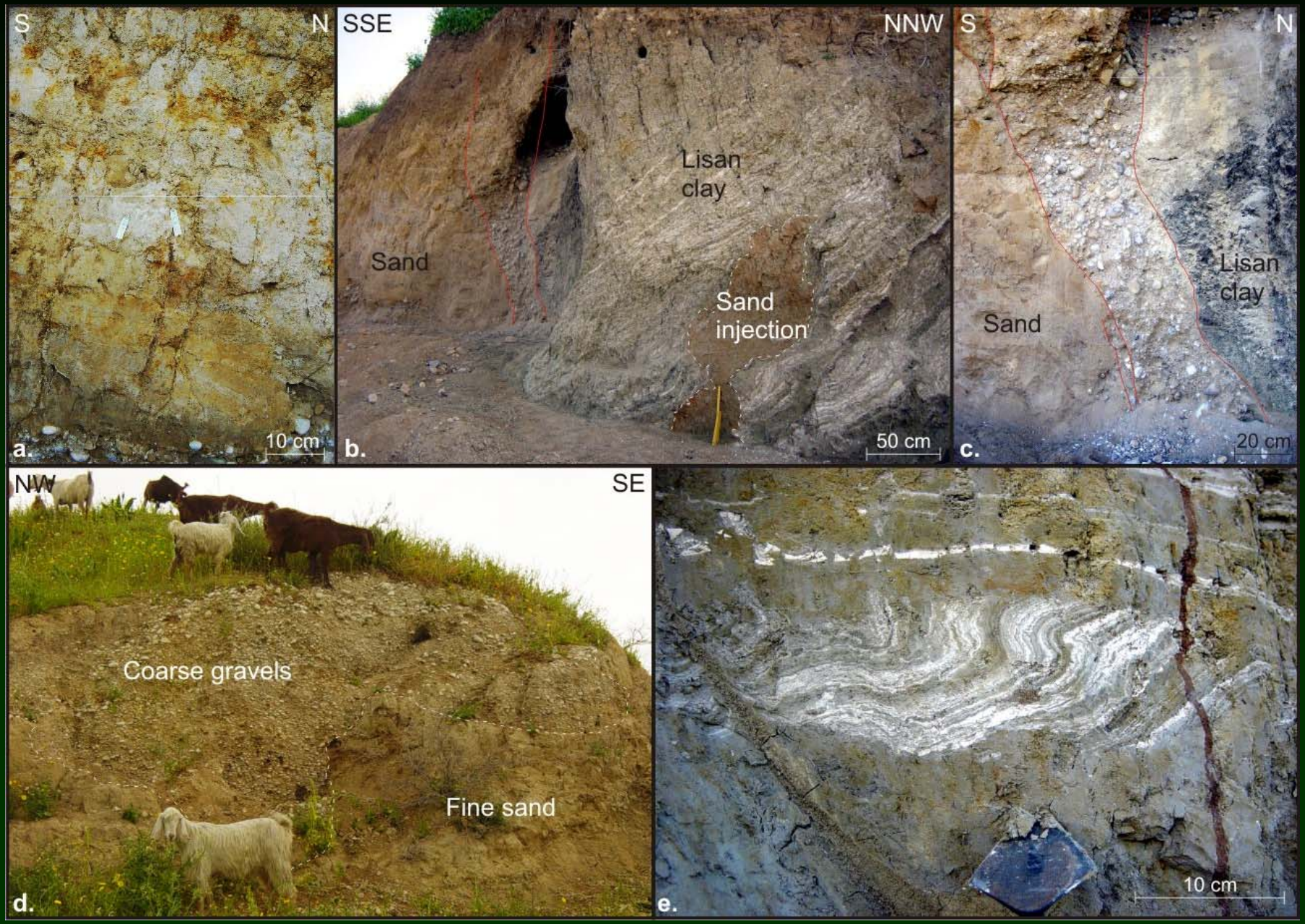
The S edge (deep green) of the present stream E1/W1 is offset by ~ **7 m**

The S stream W2 has no equivalent E of the fault:
it is a beheaded remnant
offset by ~ **114 m**

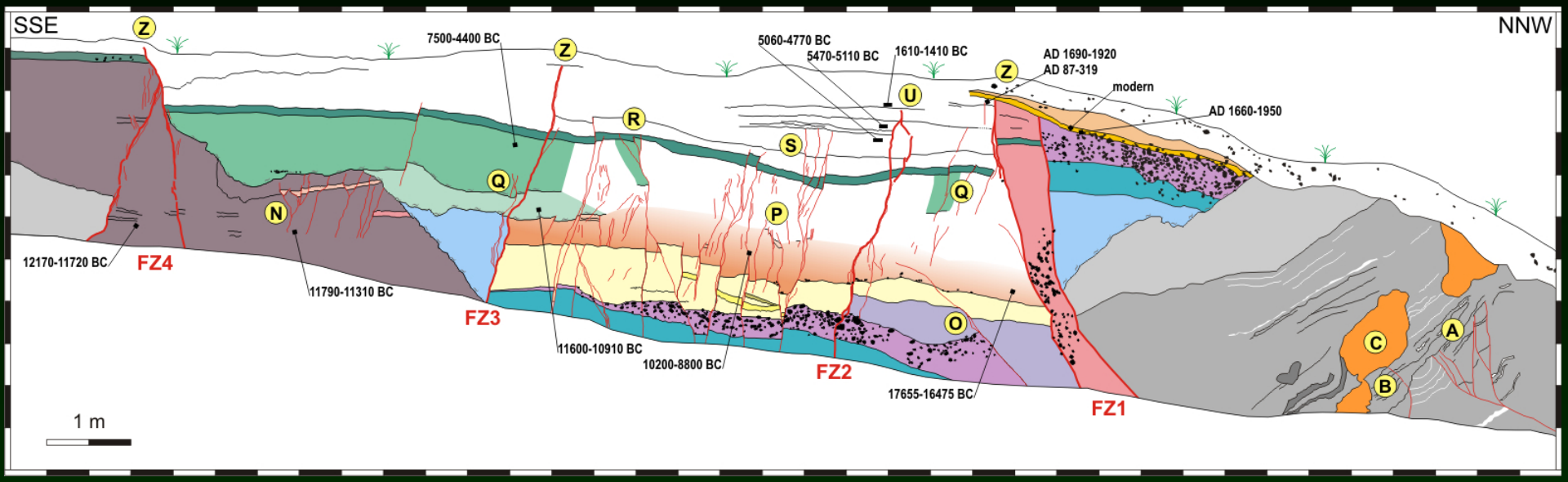




Tell Saydiyeh



Trenches at Tell Saydiyeh



Ferry et al., in prép.

Event Z : before AD 1660 – 1950 ?

Event U : 5040 - 1410 BC

Event S : 5470 - 5000 BC

Event R : 7500 - 5500 BC

Event Q : 10900 - 7500 BC

Event P : 11500 - 10500 BC

Event O : 12060 - 10910 BC

Event N : 12060 - 11500 BC

Events C, B, A : 18 – 15 ka BP

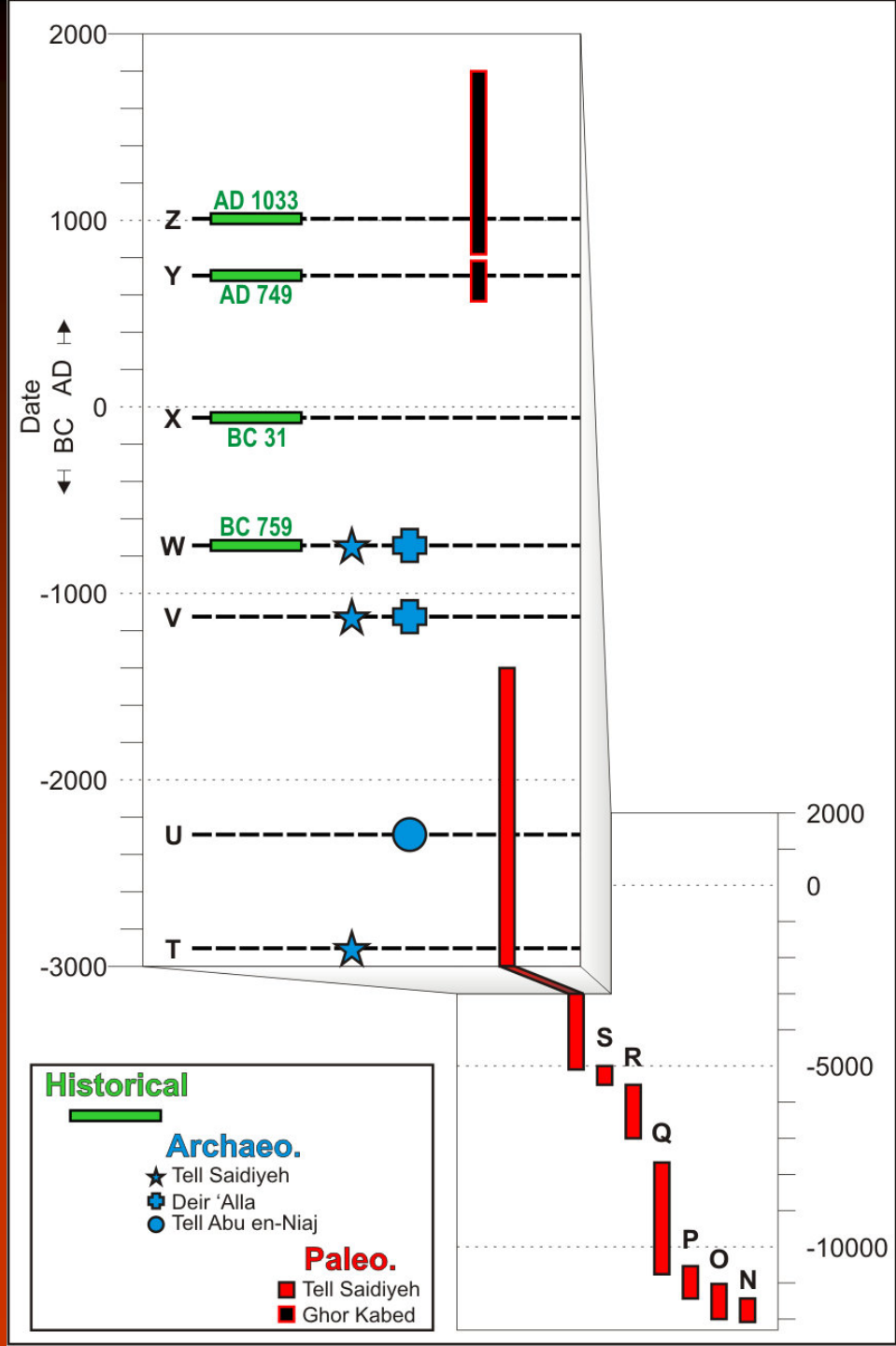
Integrated catalogue

RI = ~1000 yr

284 yr < RI < 2335 yr

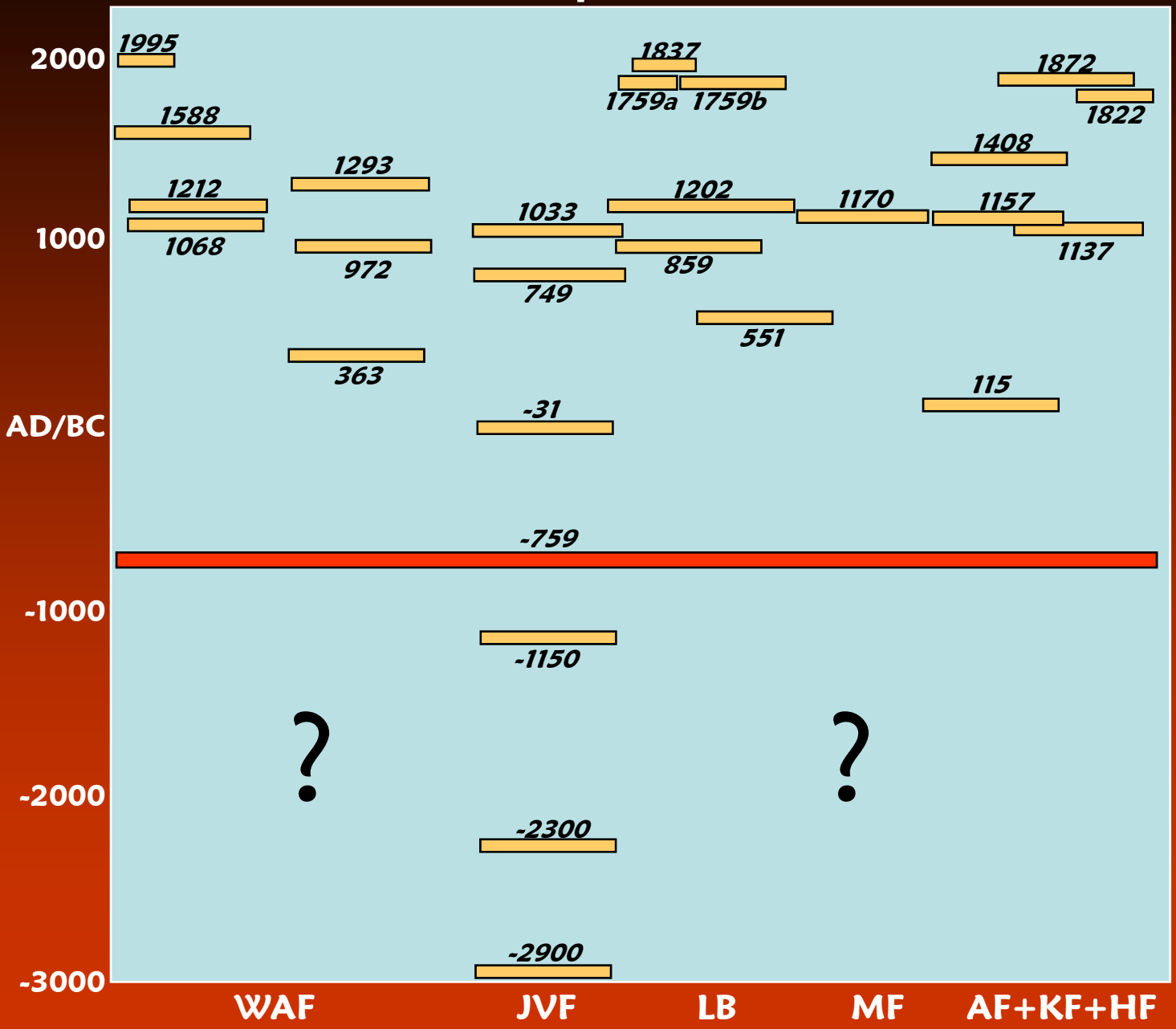
Clustering

Complementary methods

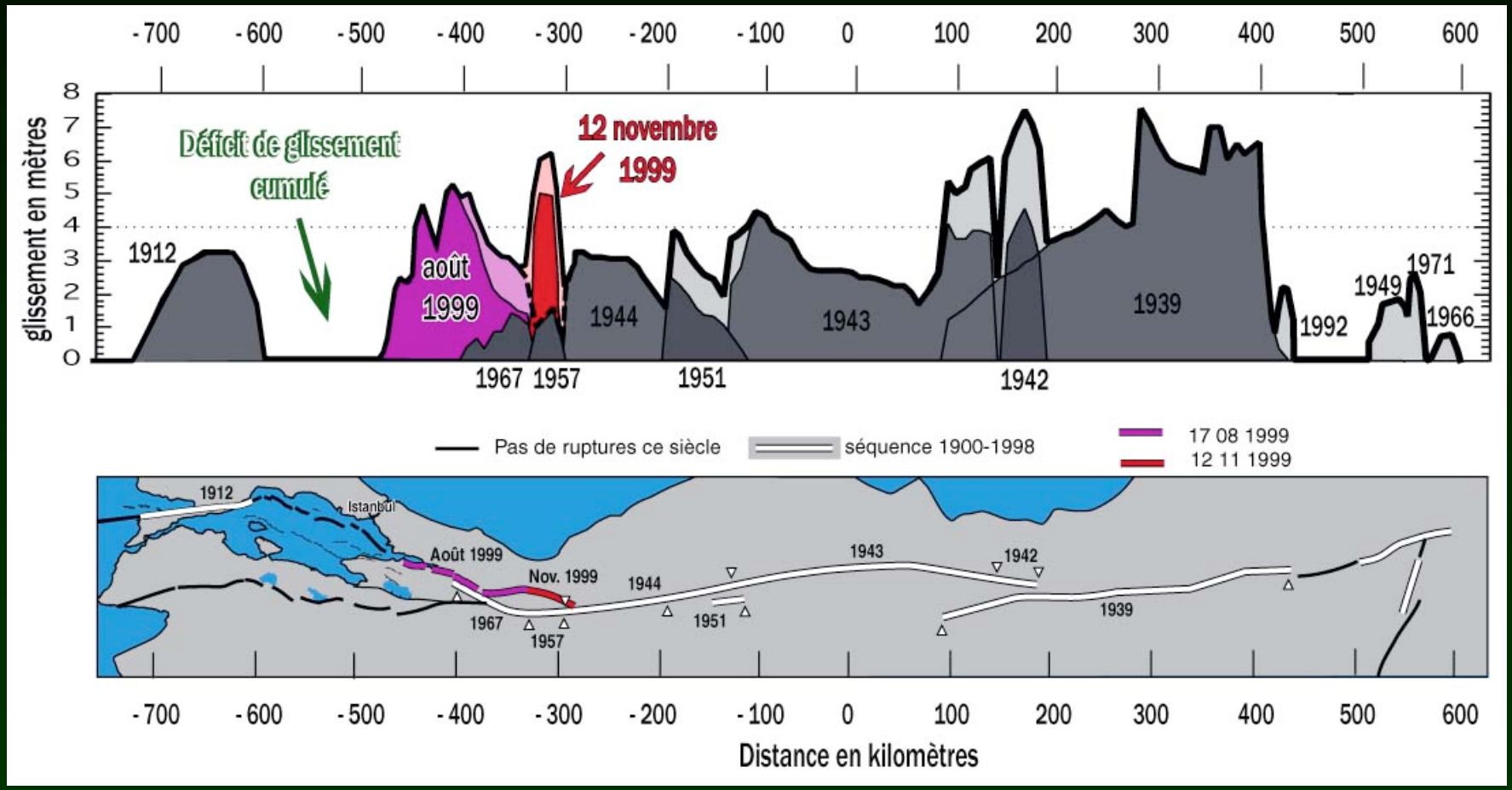


Ferry et al., in prép.

Seismic sequences, DSF



Seismic sequences, NAF



Slip rate

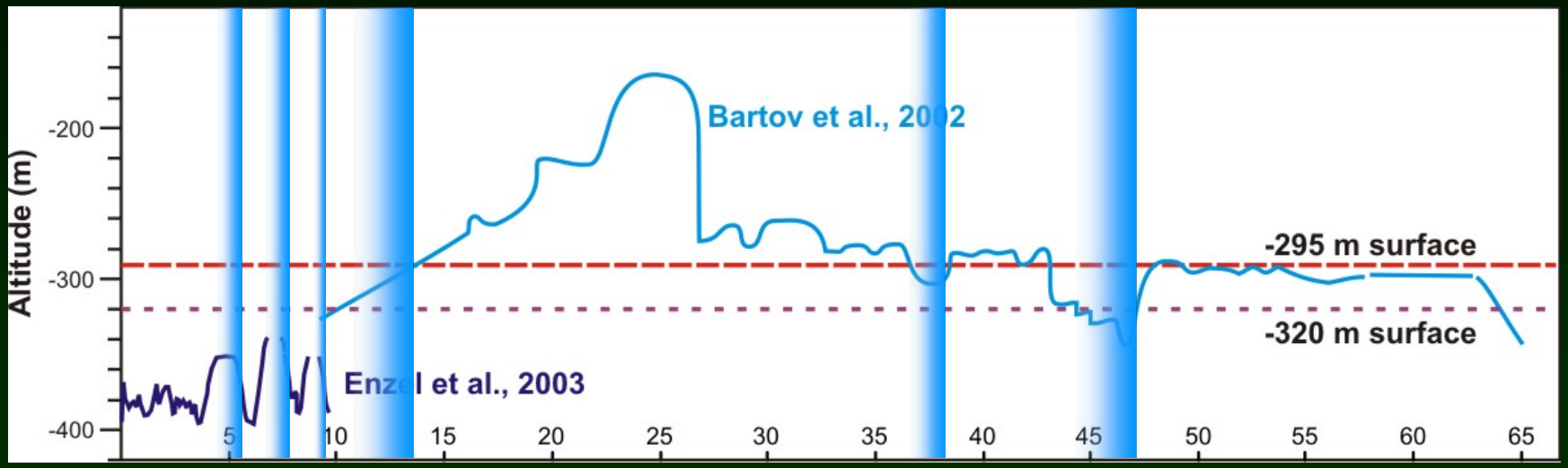
Geomorphology, climatology and tectonics

Climatic origin of gullies

1. Drop of the lake level below the terrace

2. Intense rainfall period

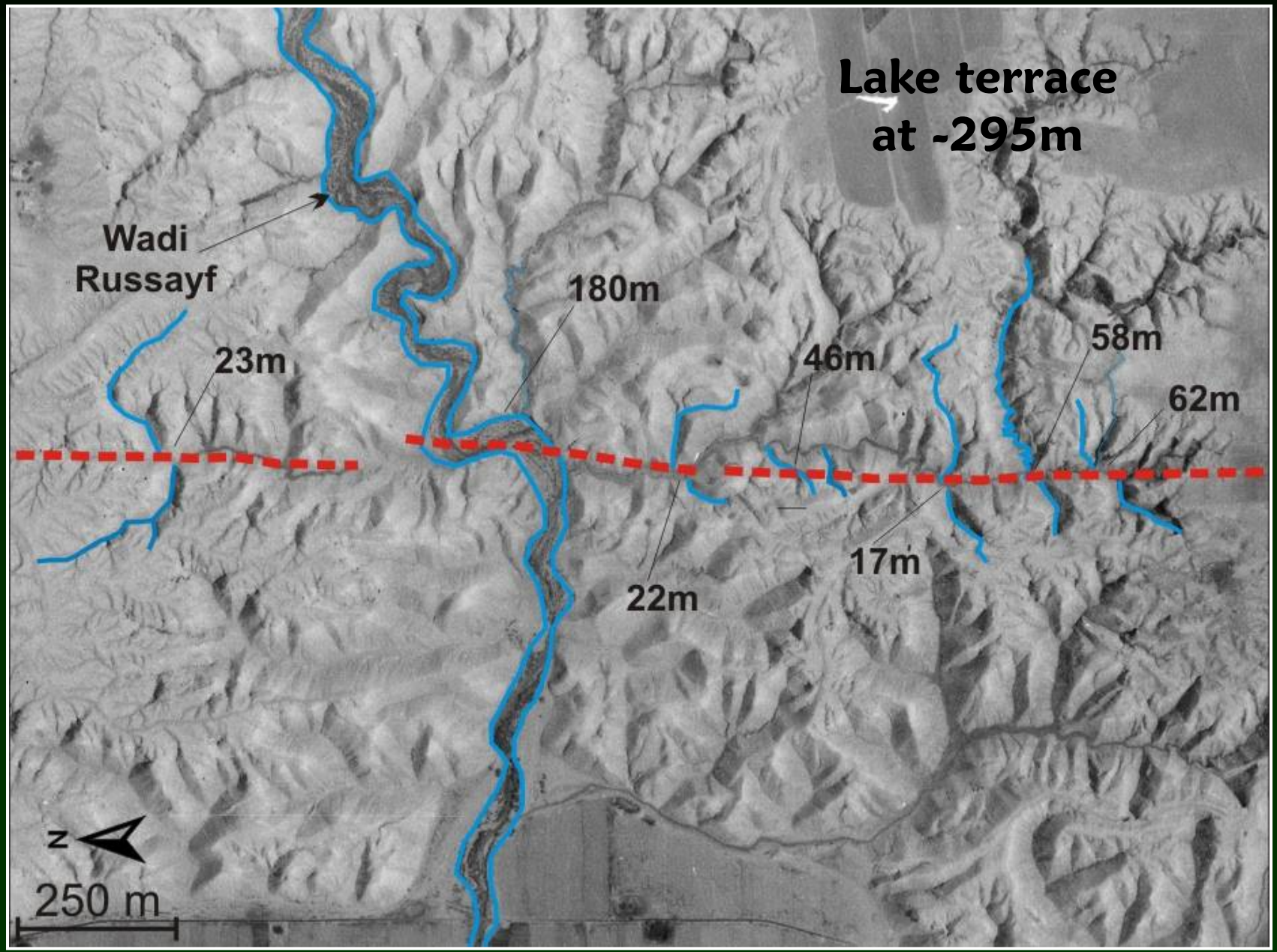
Age of incisions



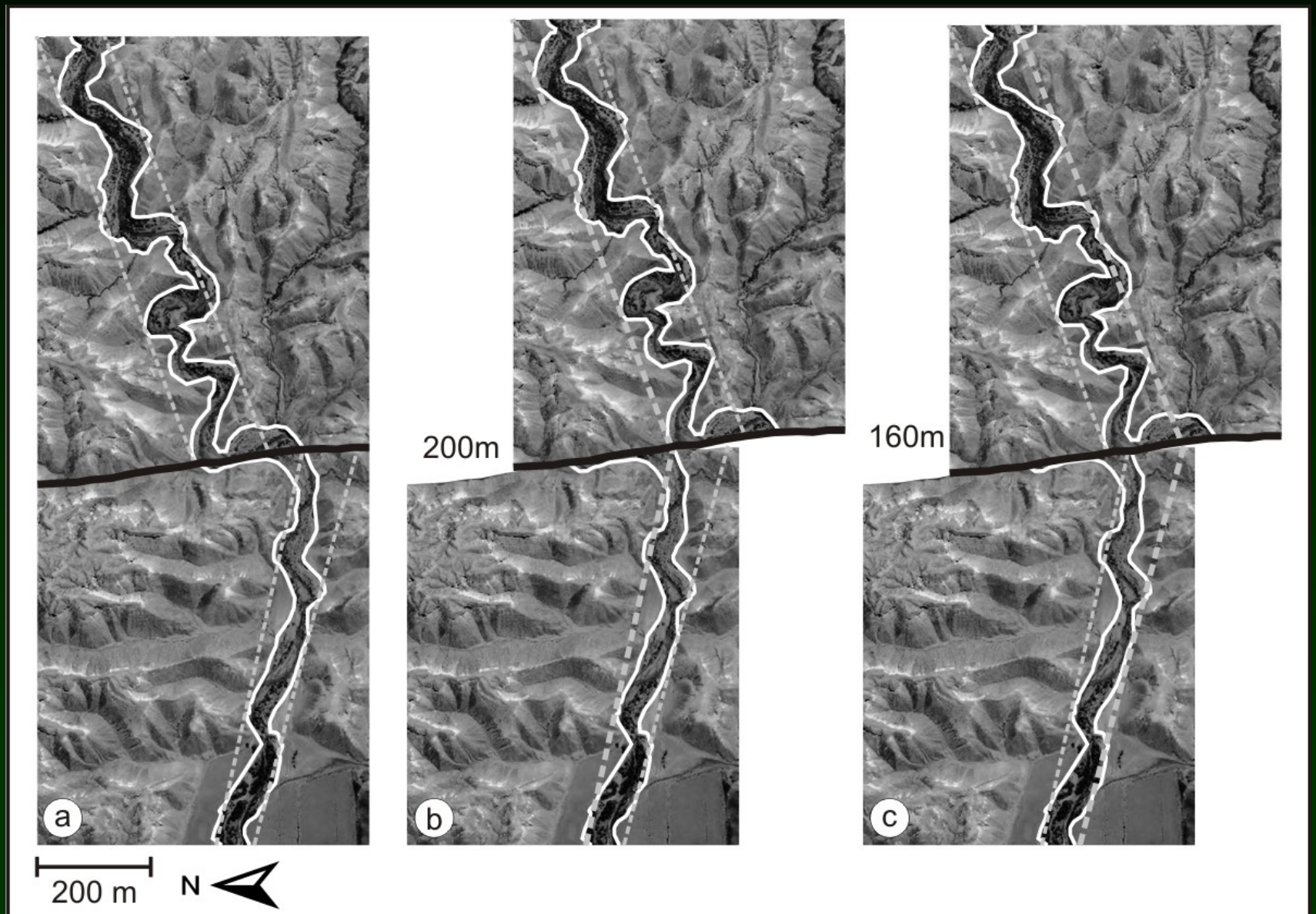
→ Six generations of incisions at:

47.5 ka BP, 37.5 ka BP, 13 ka BP, 9 ka BP, 7 ka BP et 5 ka BP

Ghor Katar


Lake terrace
at -295m
Wadi
Russayf
180m
23m
46m
58m
62m
22m
17m
N
250 m

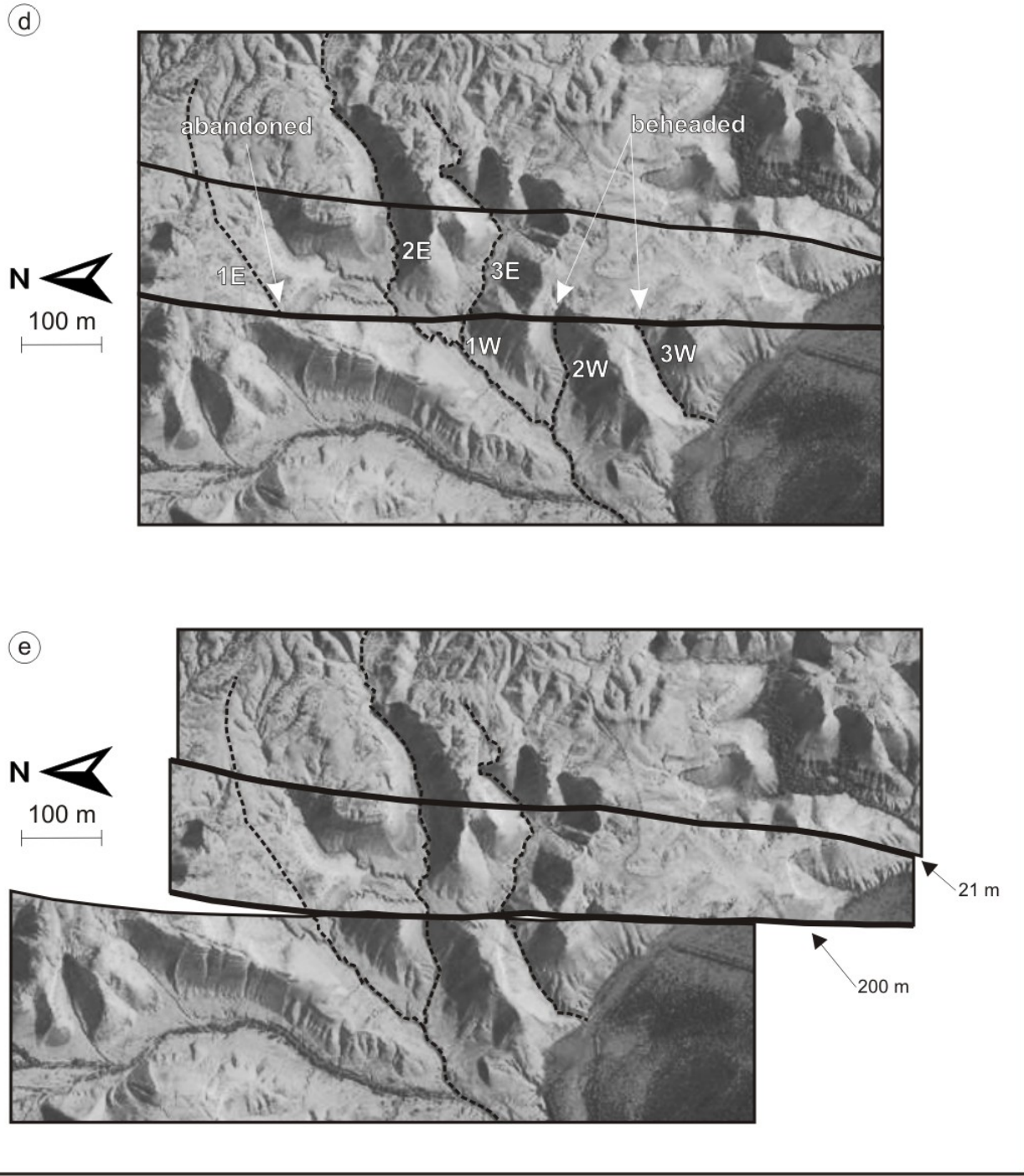
Retro-deformation of Wadi Russayf



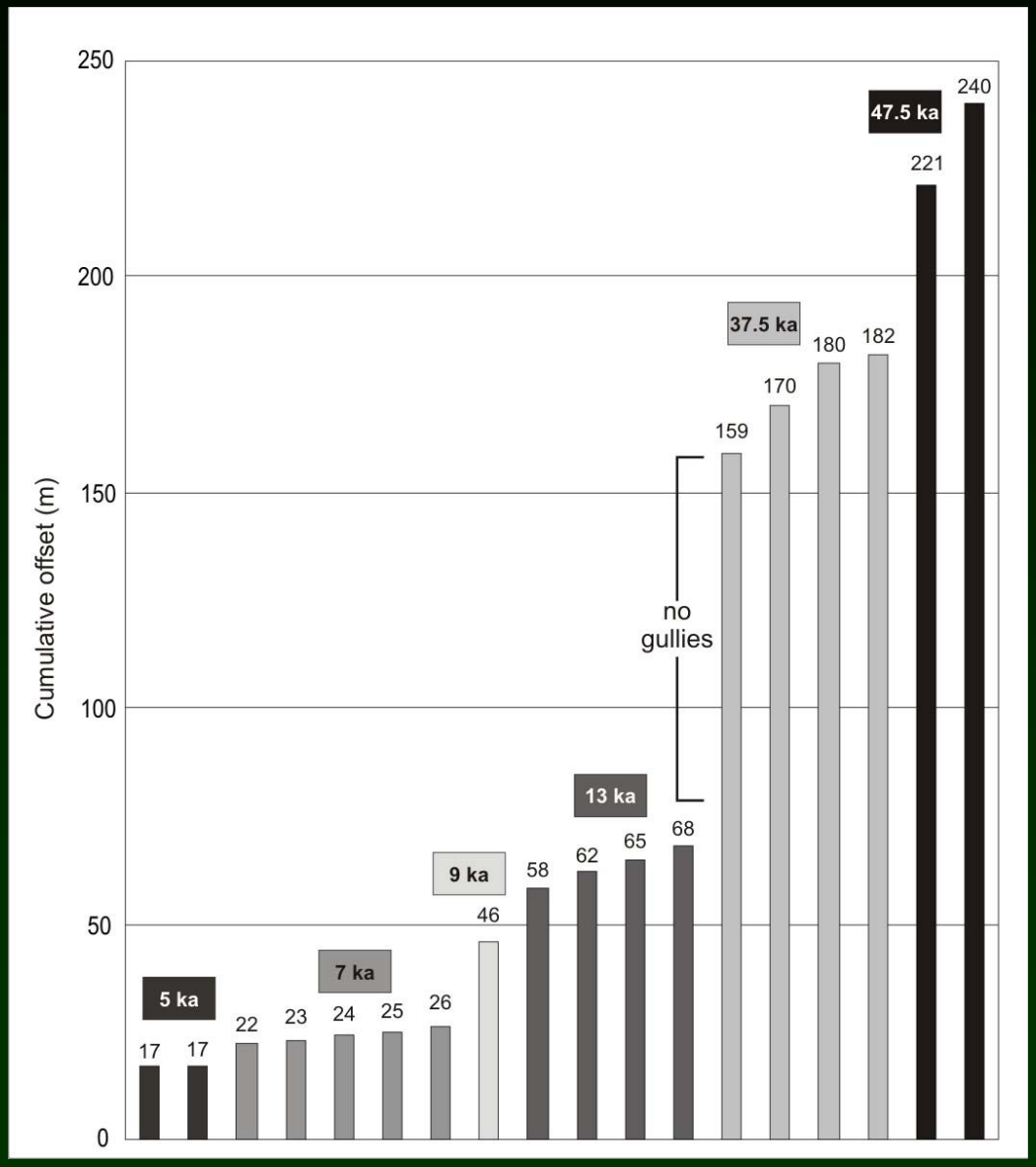
Ghor Al-Mendessa

Cumulative displacement:

221 ± 25 m

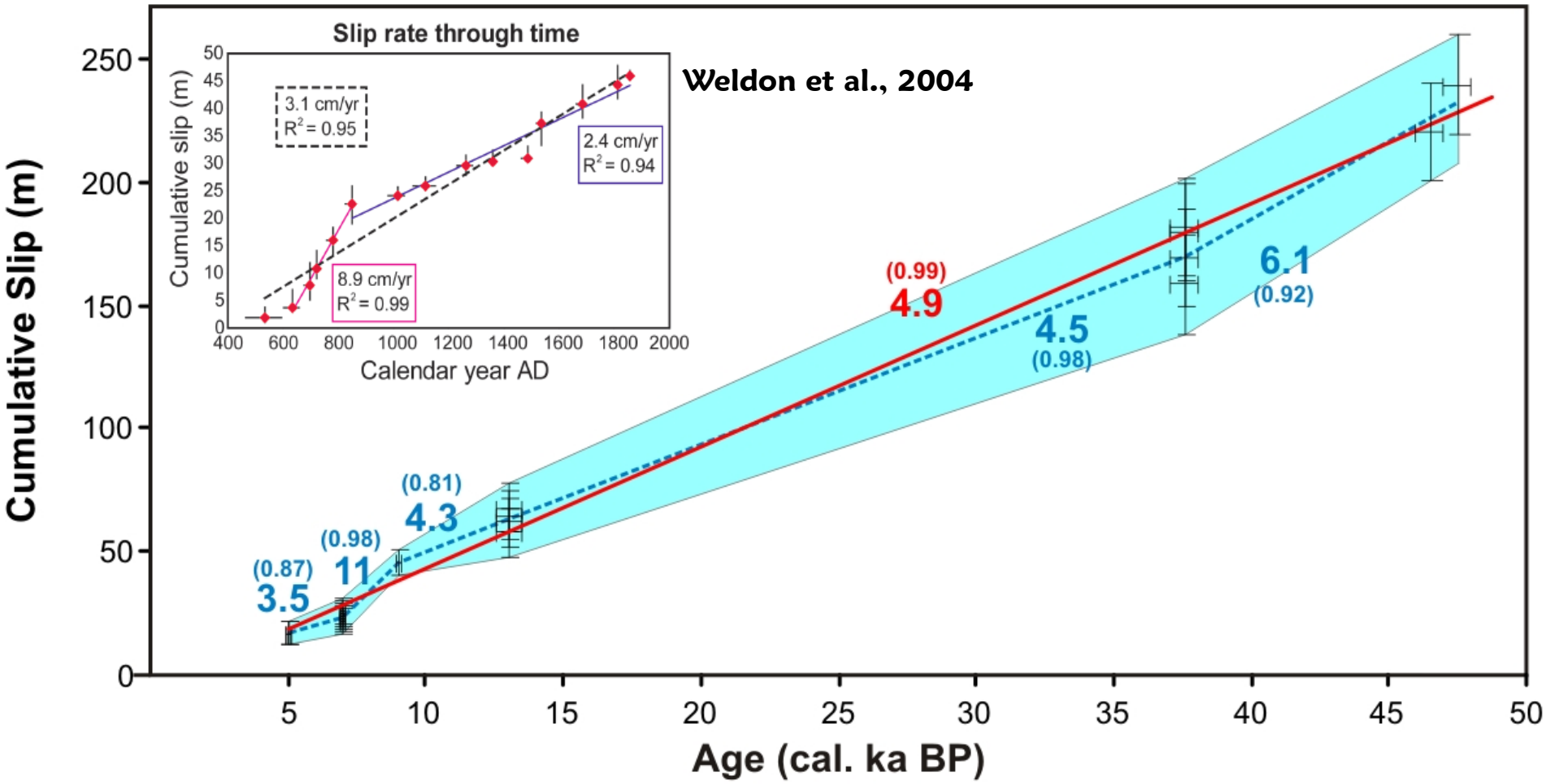


Cumulative displacements



Six classes of displacements → Six generations of incisions

Variable slip rate



Ferry et al., 2007, EPSL

Thank you…

Perspectives

- Generalize paleoseismic studies on ancient eq
- Interpret GPS and Geology within the seismic cycle
- Develop high-resolution methods
  - LiDAR: identification slow faults, variations of slip rate
  - Field spectroscopy for trench studies: improved accuracy of events detection, of datation resolution, of rupture complexity
- Apply that approach to characterize active faults in Portugal and improve earthquake hazard assessment