

In attesa...



Gli ultimi grandi terremoti



Milano
5 dicembre 2023



Terremoto Marocco

8 settembre 2023



MOROCCO EARTHQUAKE OF 2023

Magnitude: 6.8

Date: September 8, 2023

Location: 31.073° N 8.407° W

Depth: 18 km (11.2 mi)

Perceived shaking

Severe

Very strong

Strong

Moderate

Epicentre

Plate boundary

Fault lines

Direction of plate movement

Direction of fault movement

CANARY ISLANDS (SPAIN)

AFRICAN PLATE

EURASIAN PLATE

ATLANTIC OCEAN

Rabat

Casablanca

El Jadida

Settat

Safi

Essaouira

Marrakech

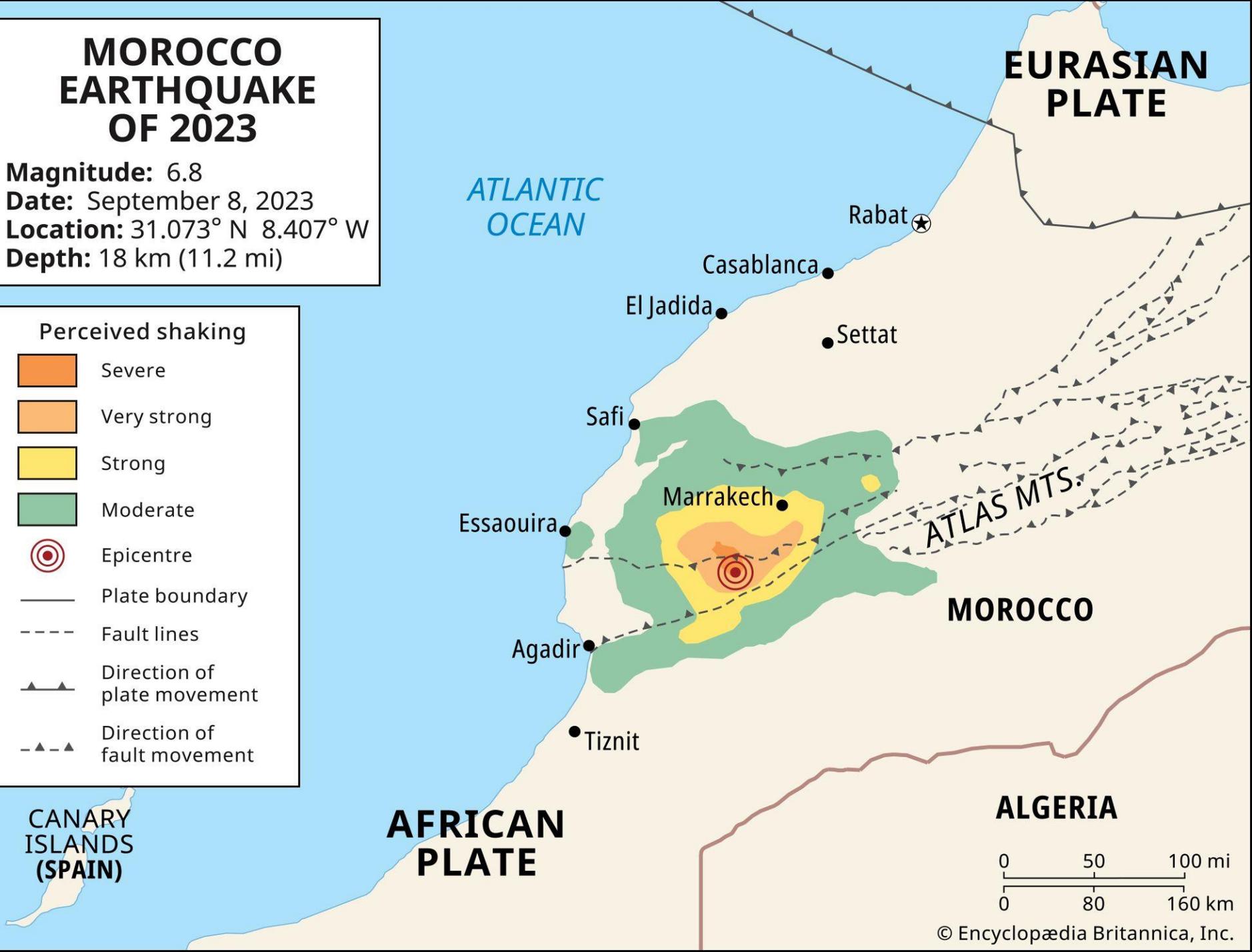
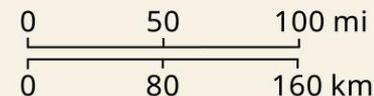
Agadir

Tiznit

ATLAS MTS.

MOROCCO

ALGERIA





Activate W
Go to Setting

09-08-2023 Fri 23:00:25

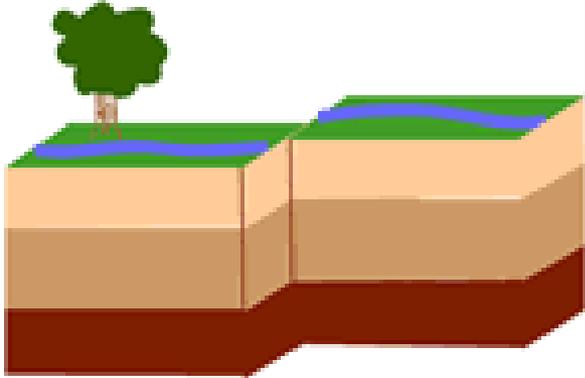


Città del Messico 2017

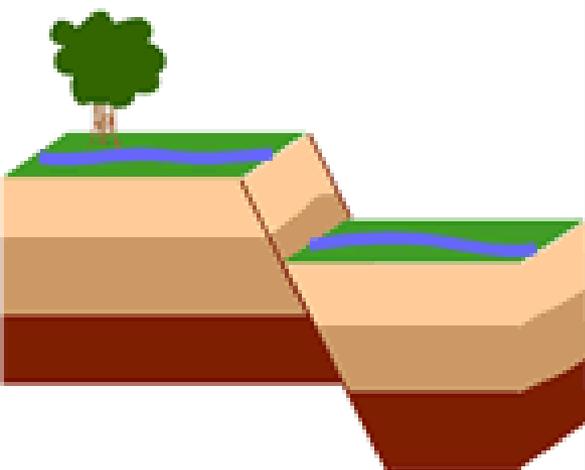


Equador

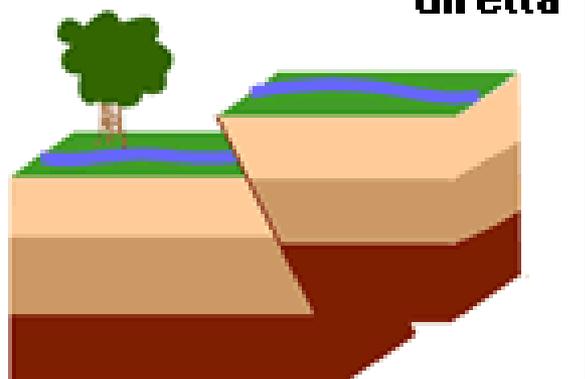




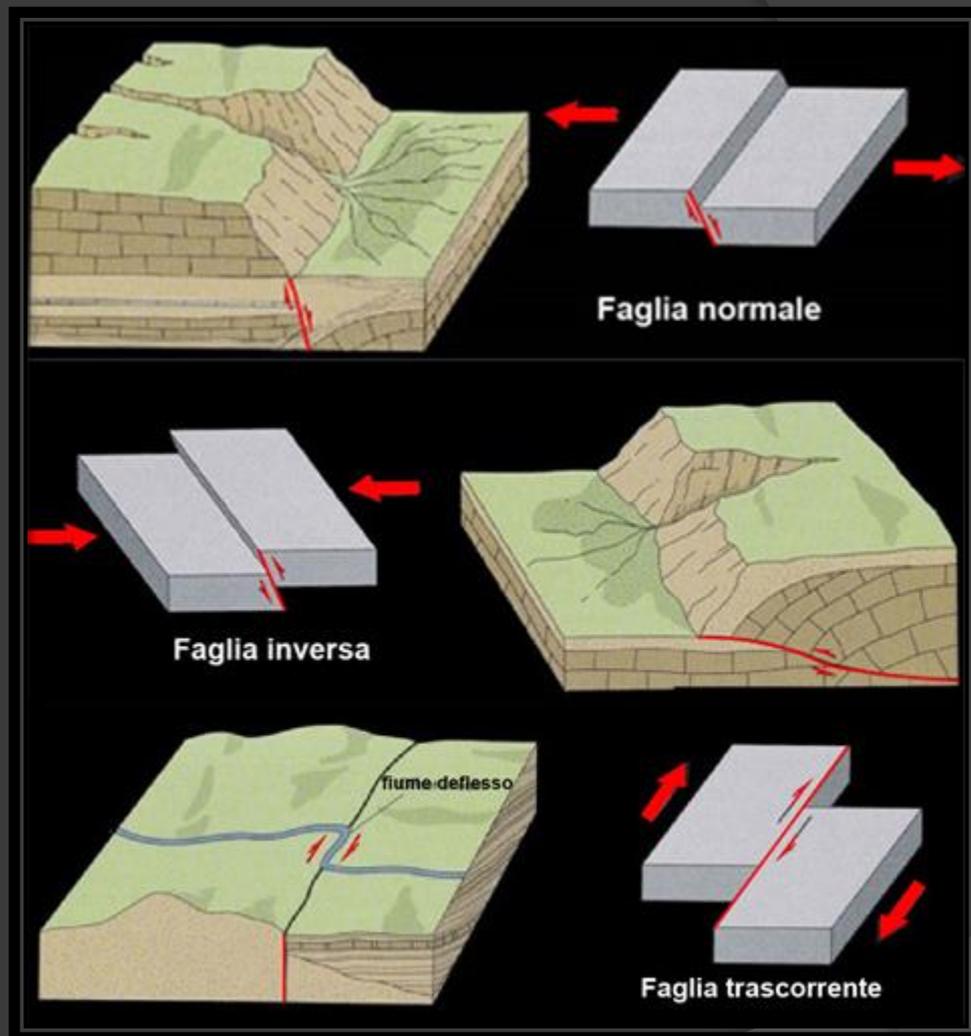
trascorrente



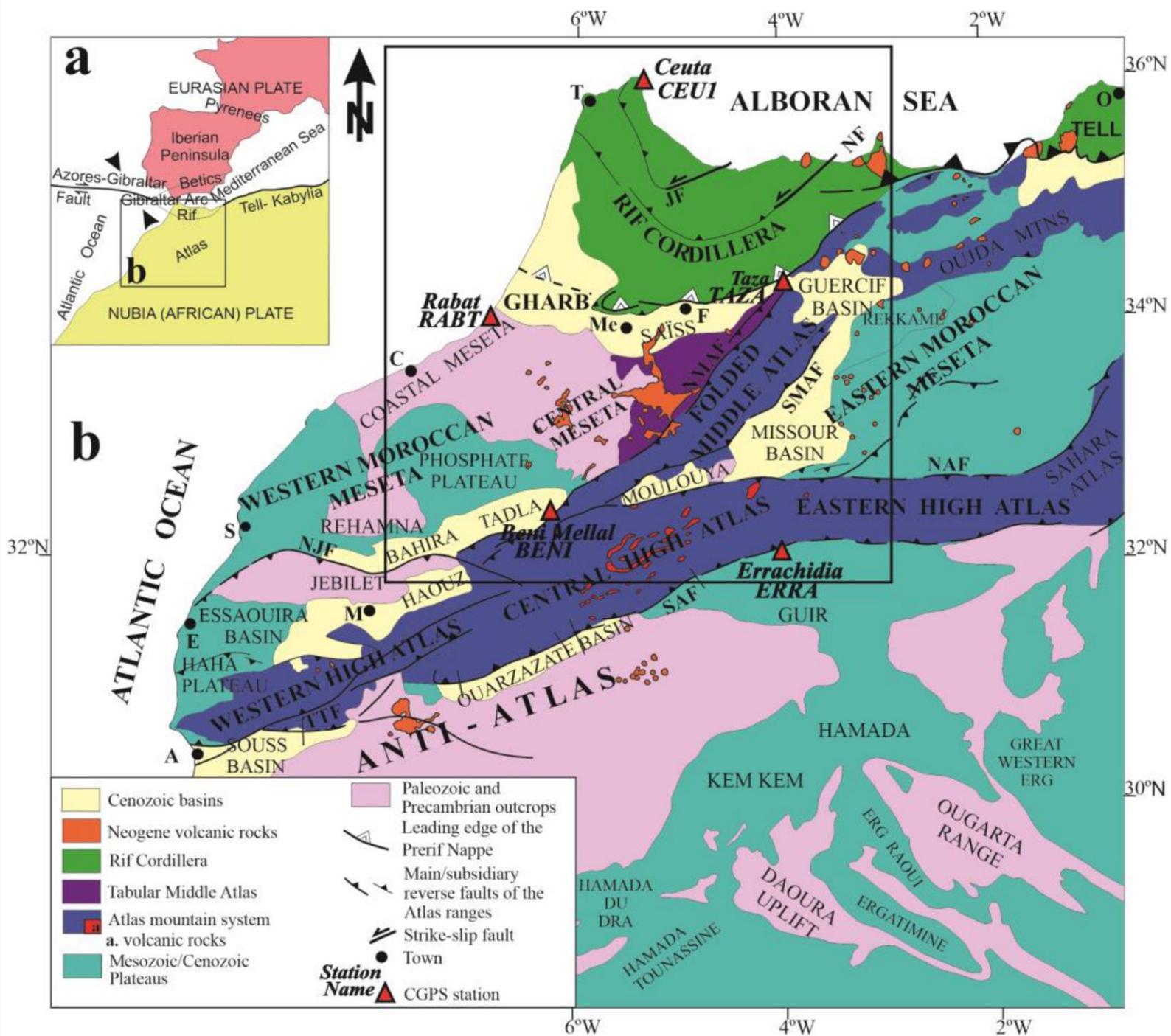
diretta

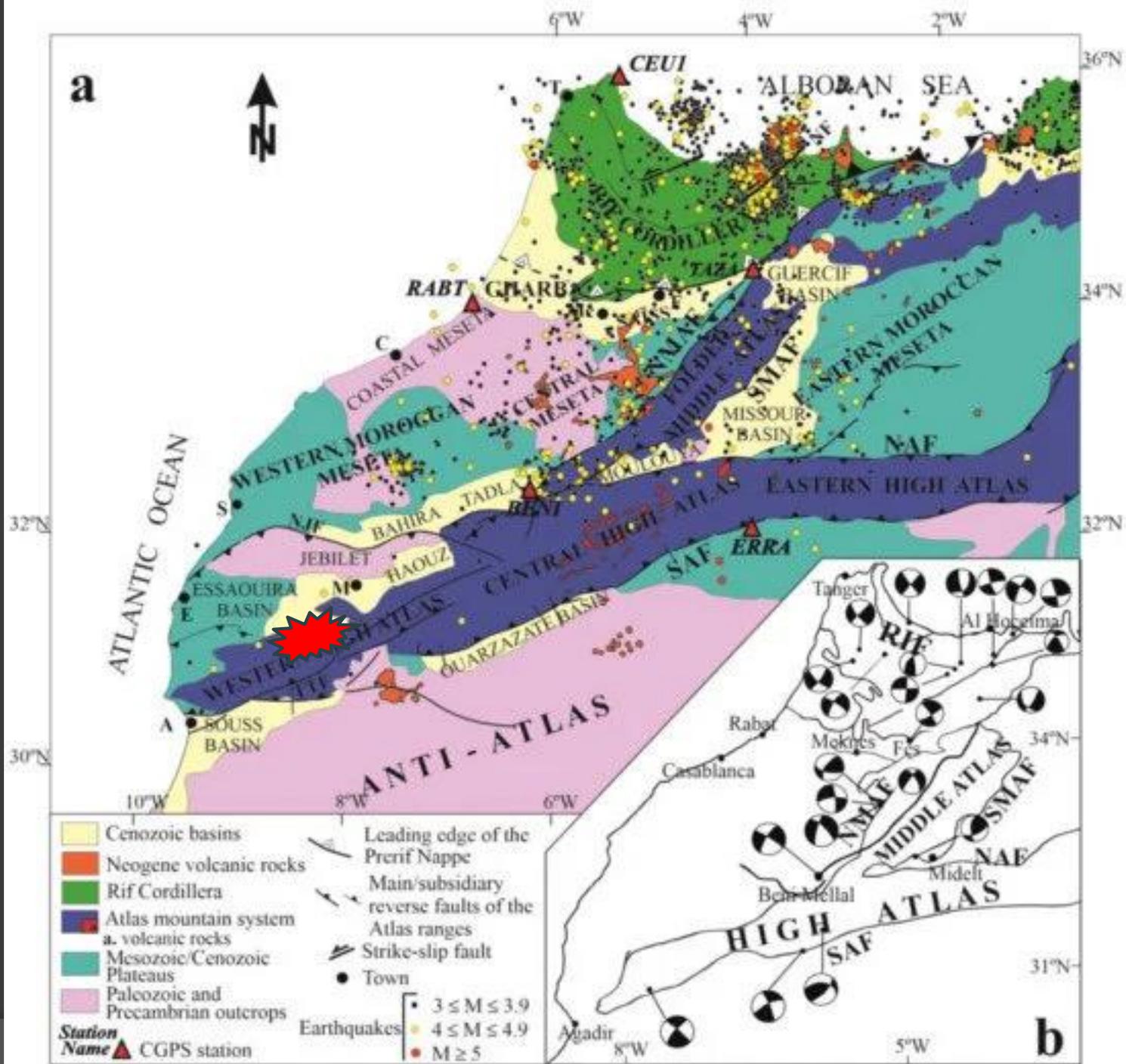


inversa

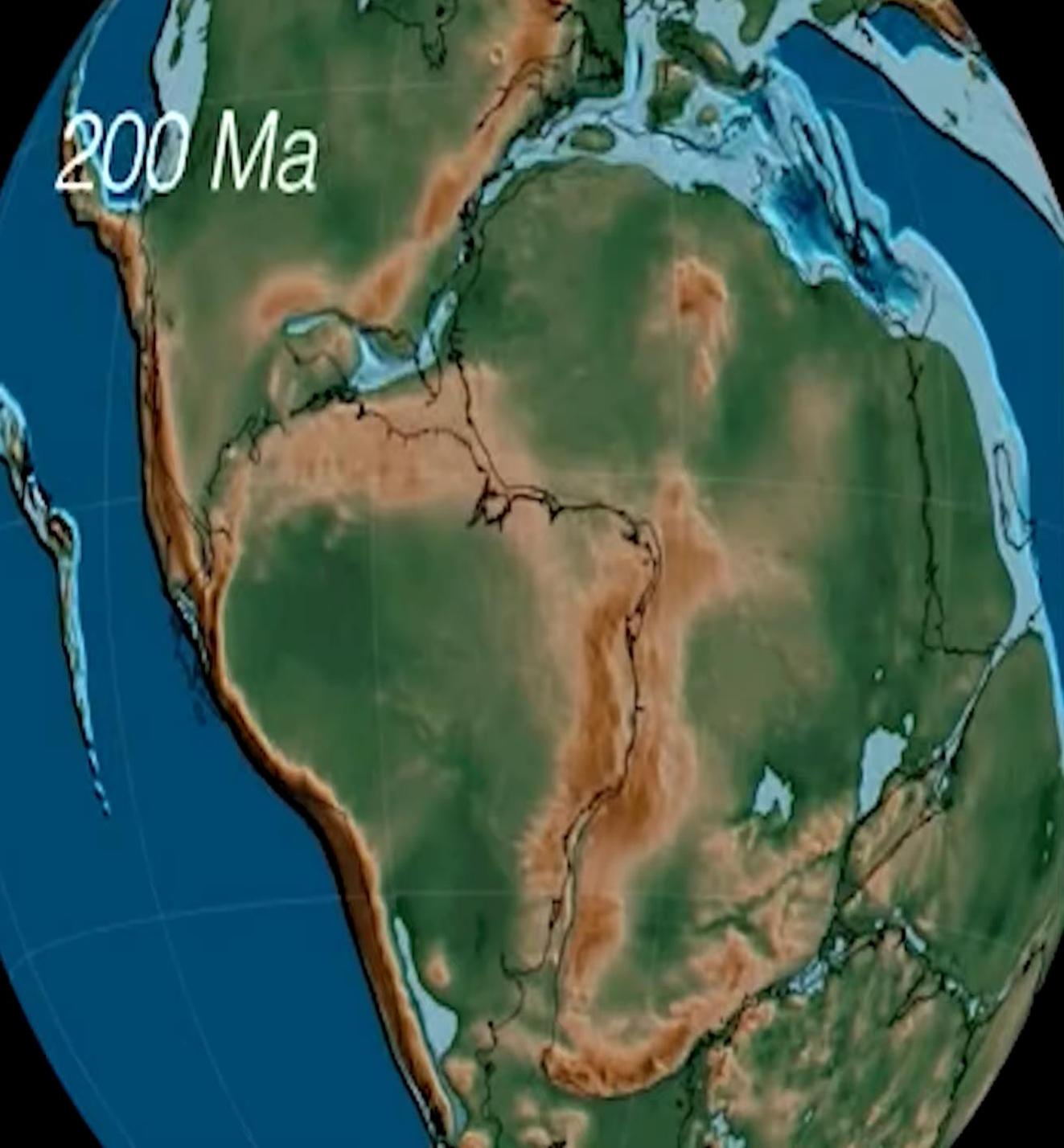






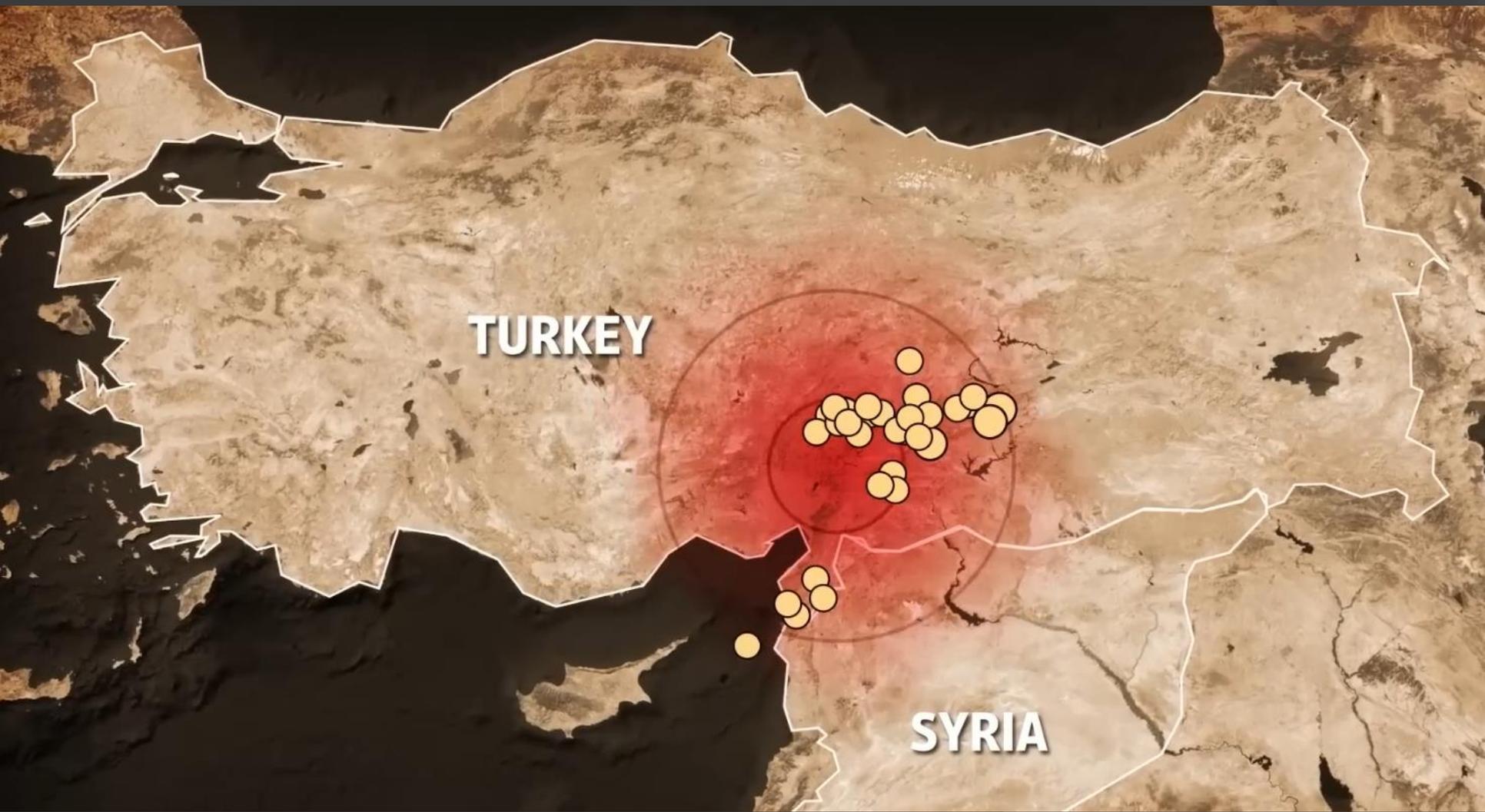


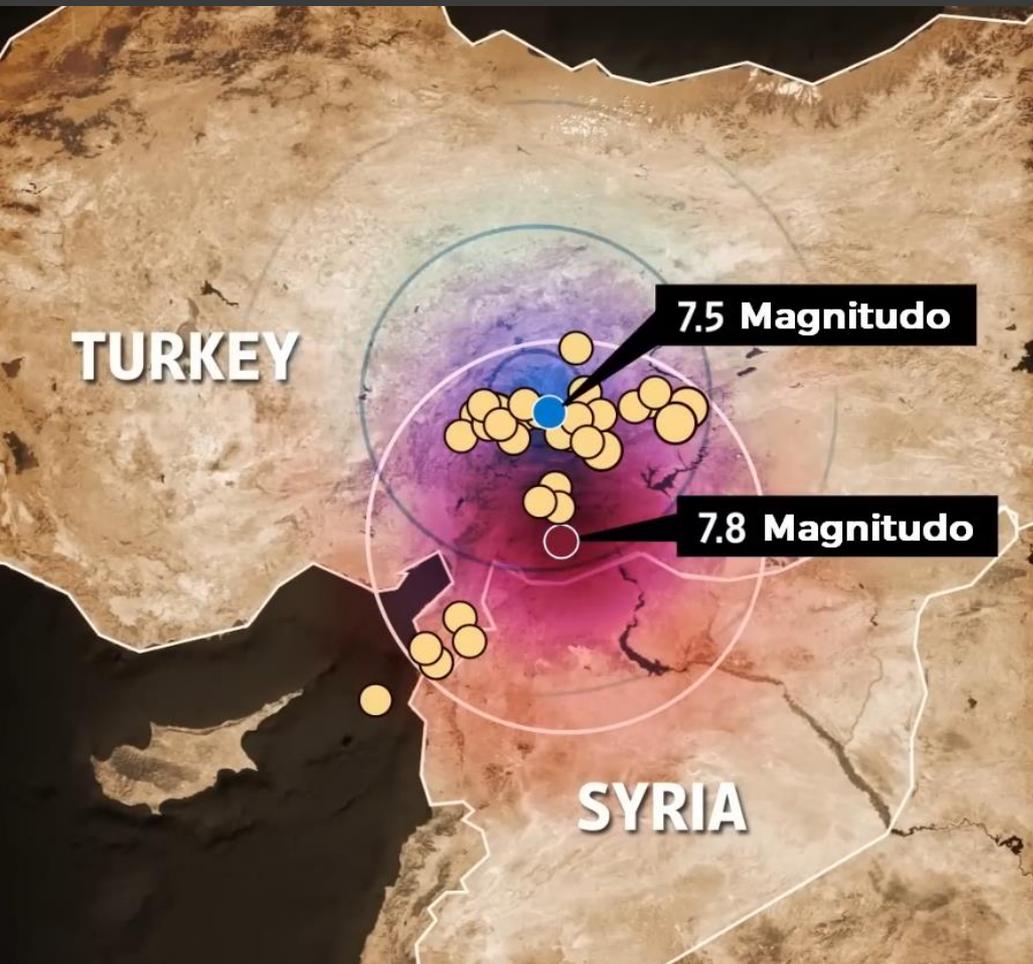
200 Ma



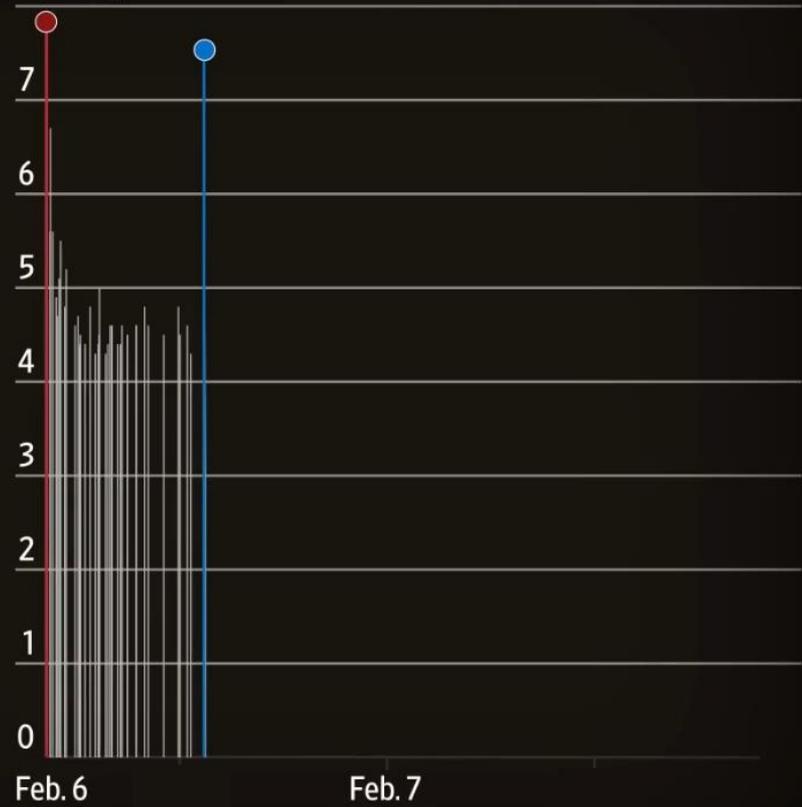
Pangea
breaks up

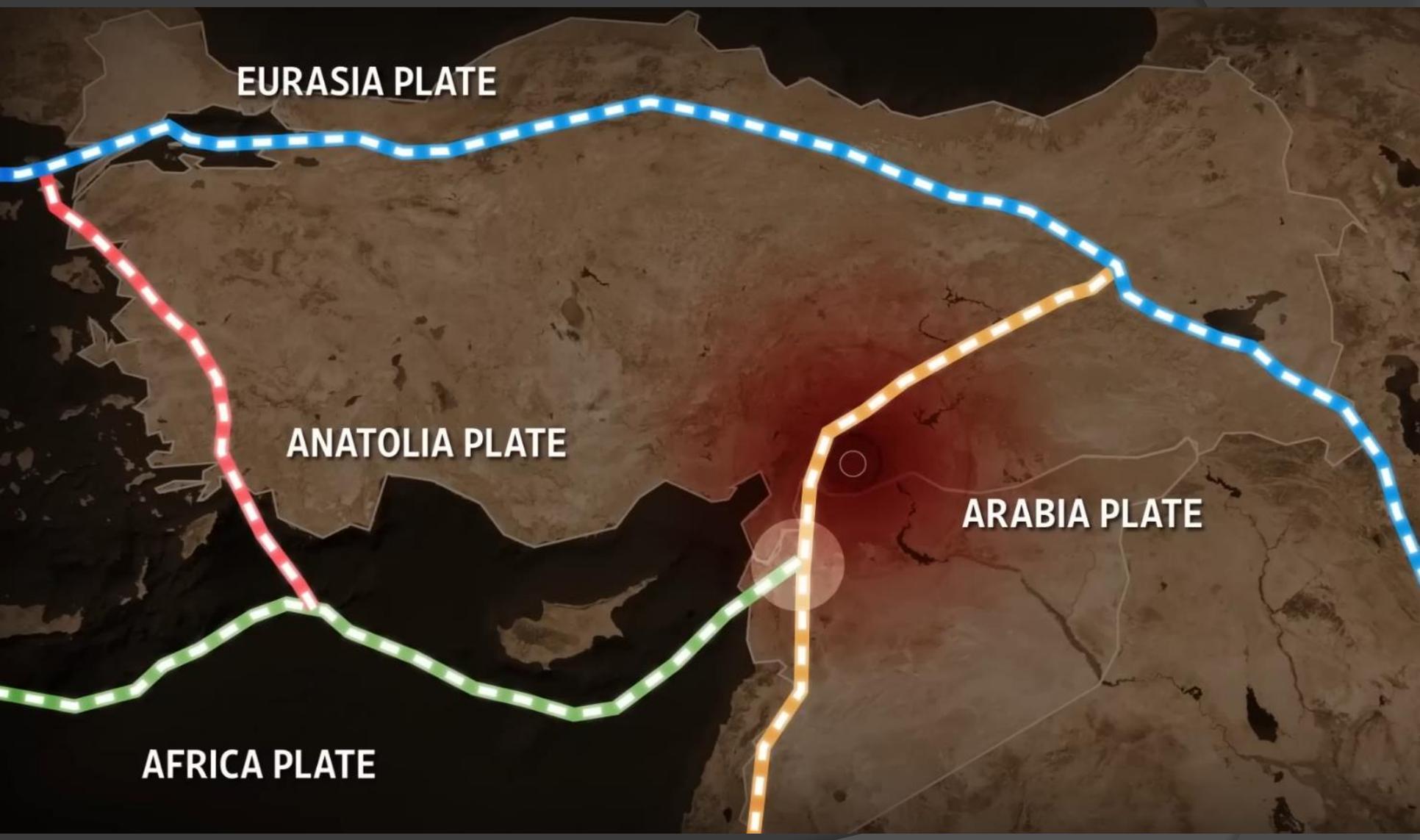
200 million
years ago to
present





8 magnitudo





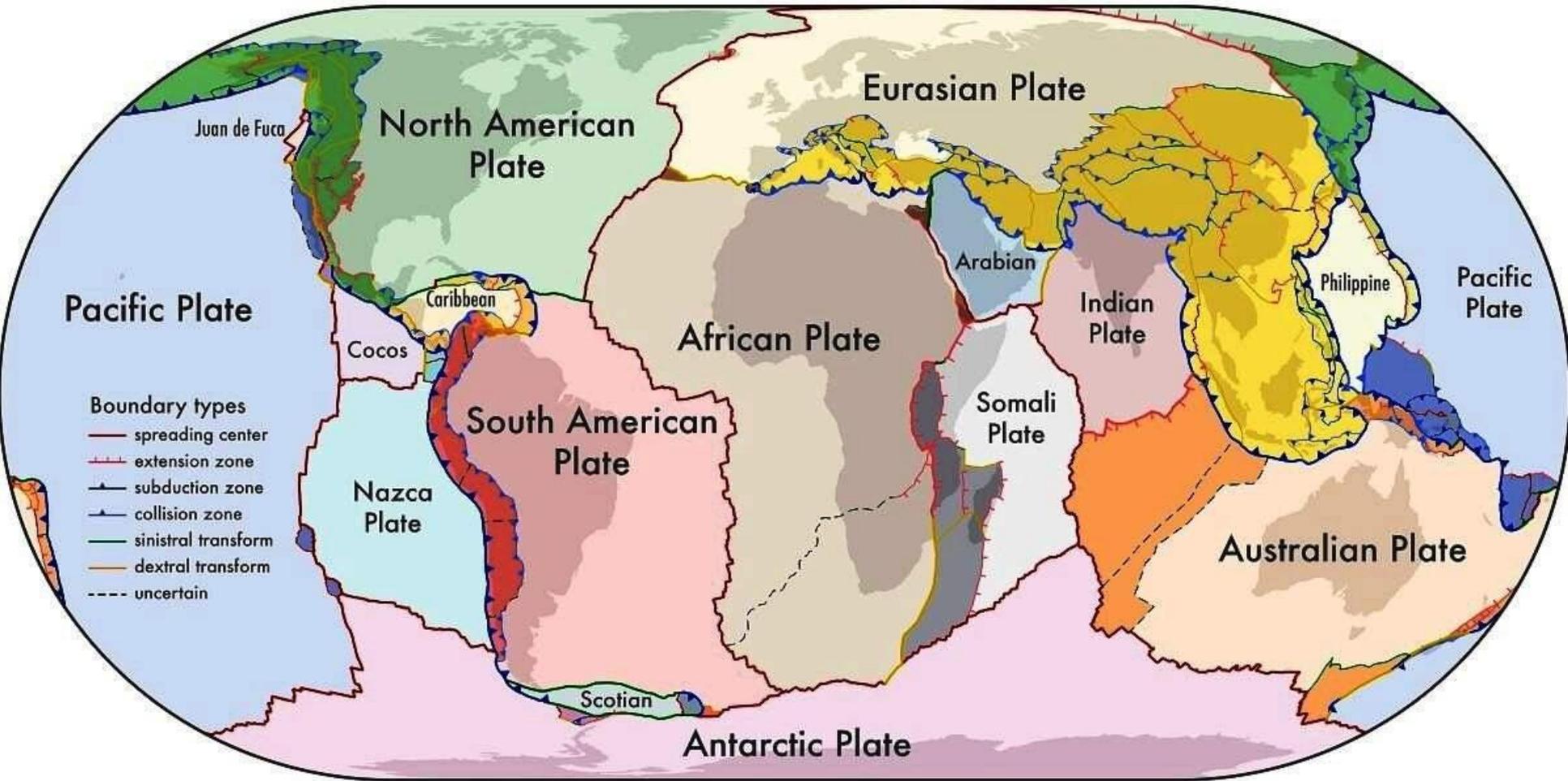
EURASIA PLATE

ANATOLIA PLATE

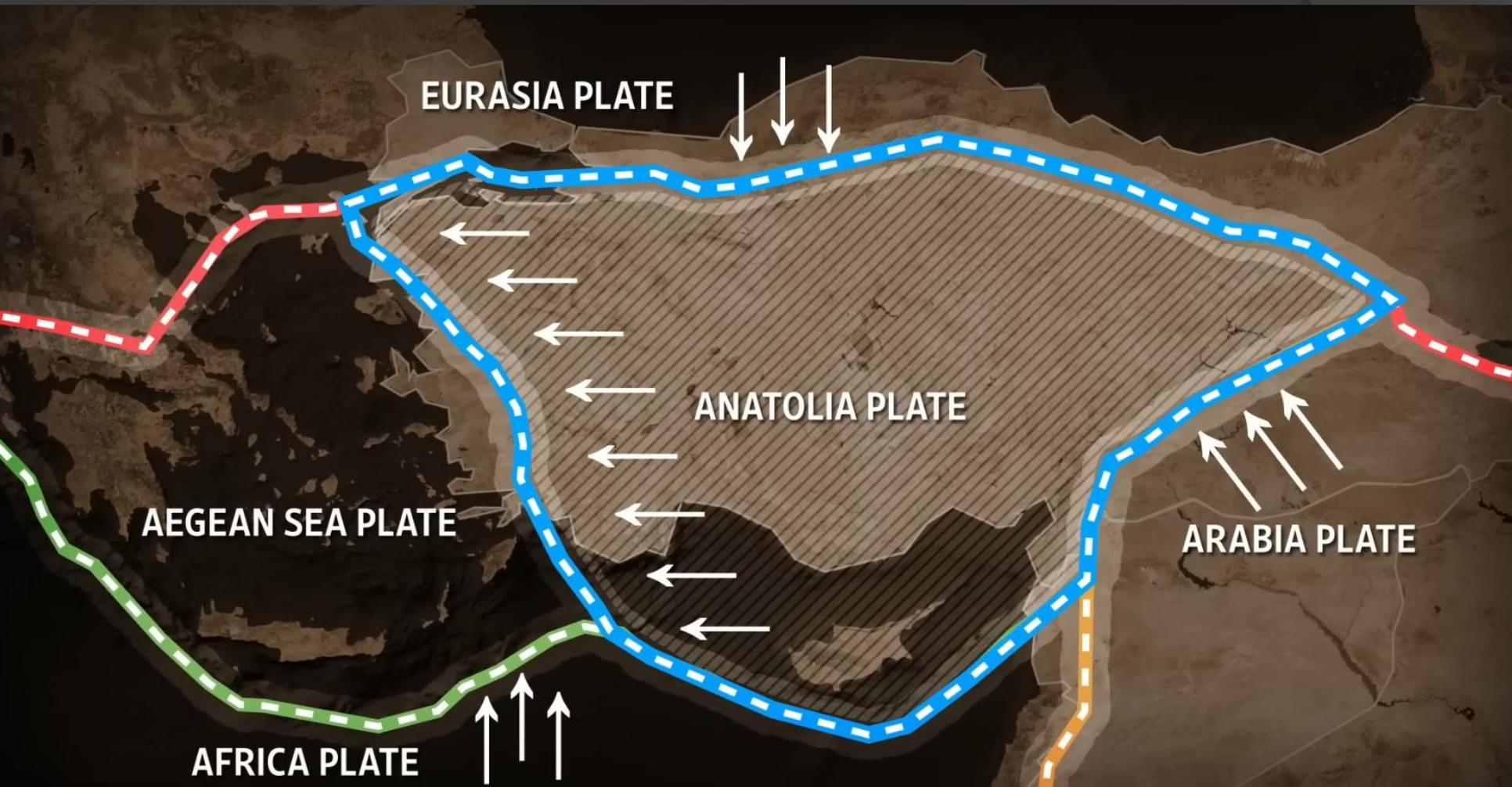
ARABIA PLATE

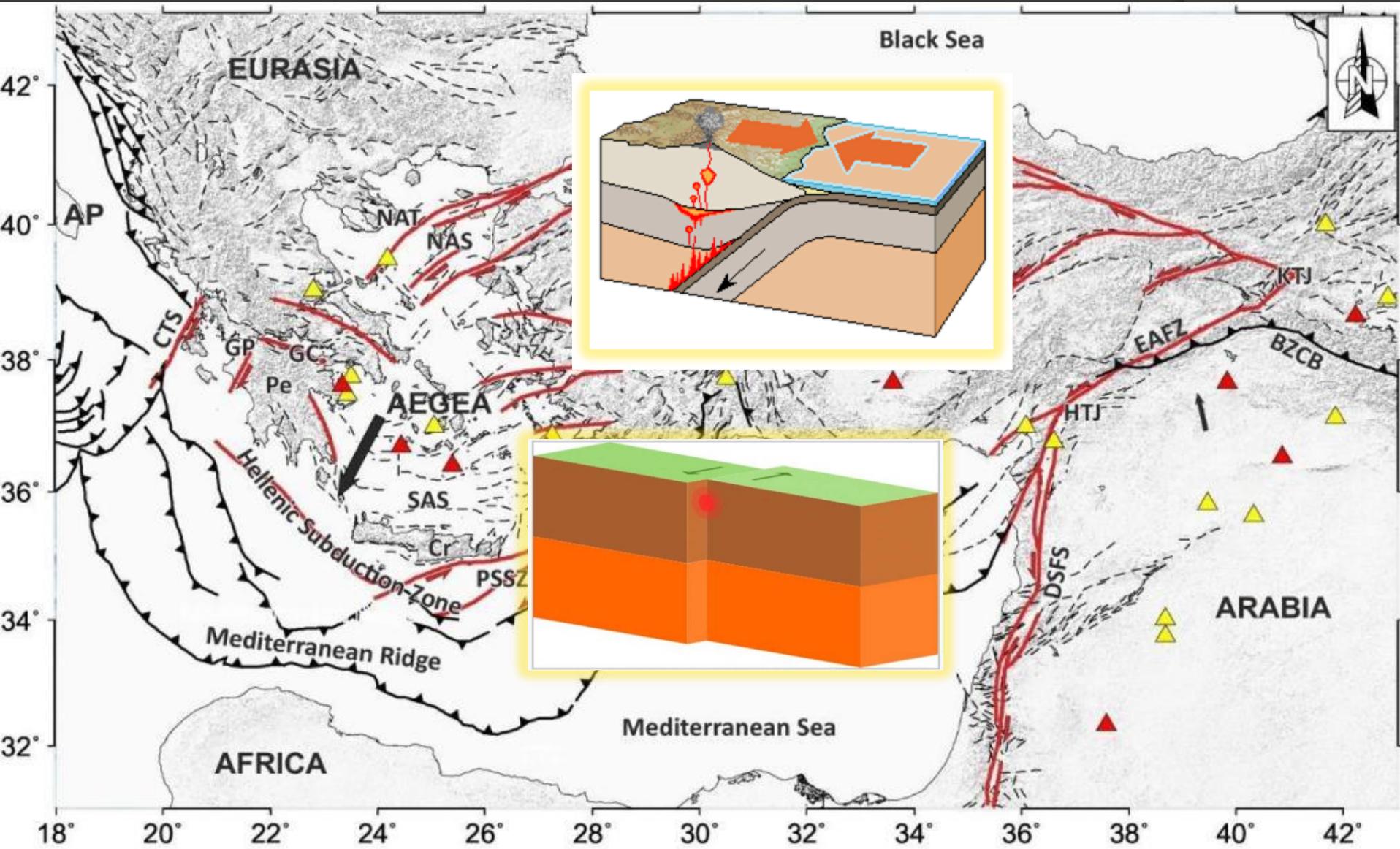
AFRICA PLATE

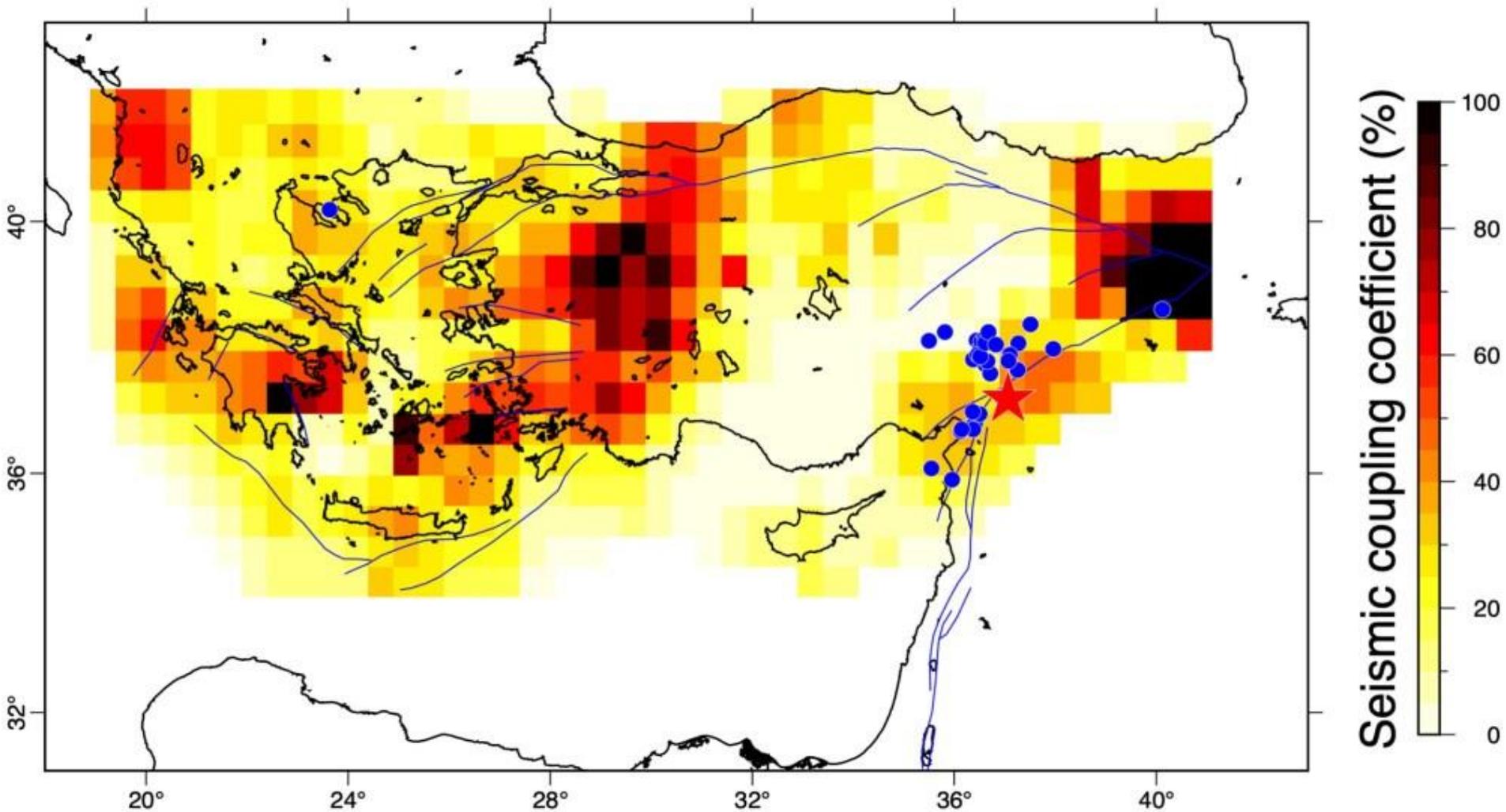
Tectonic Plates, 2022



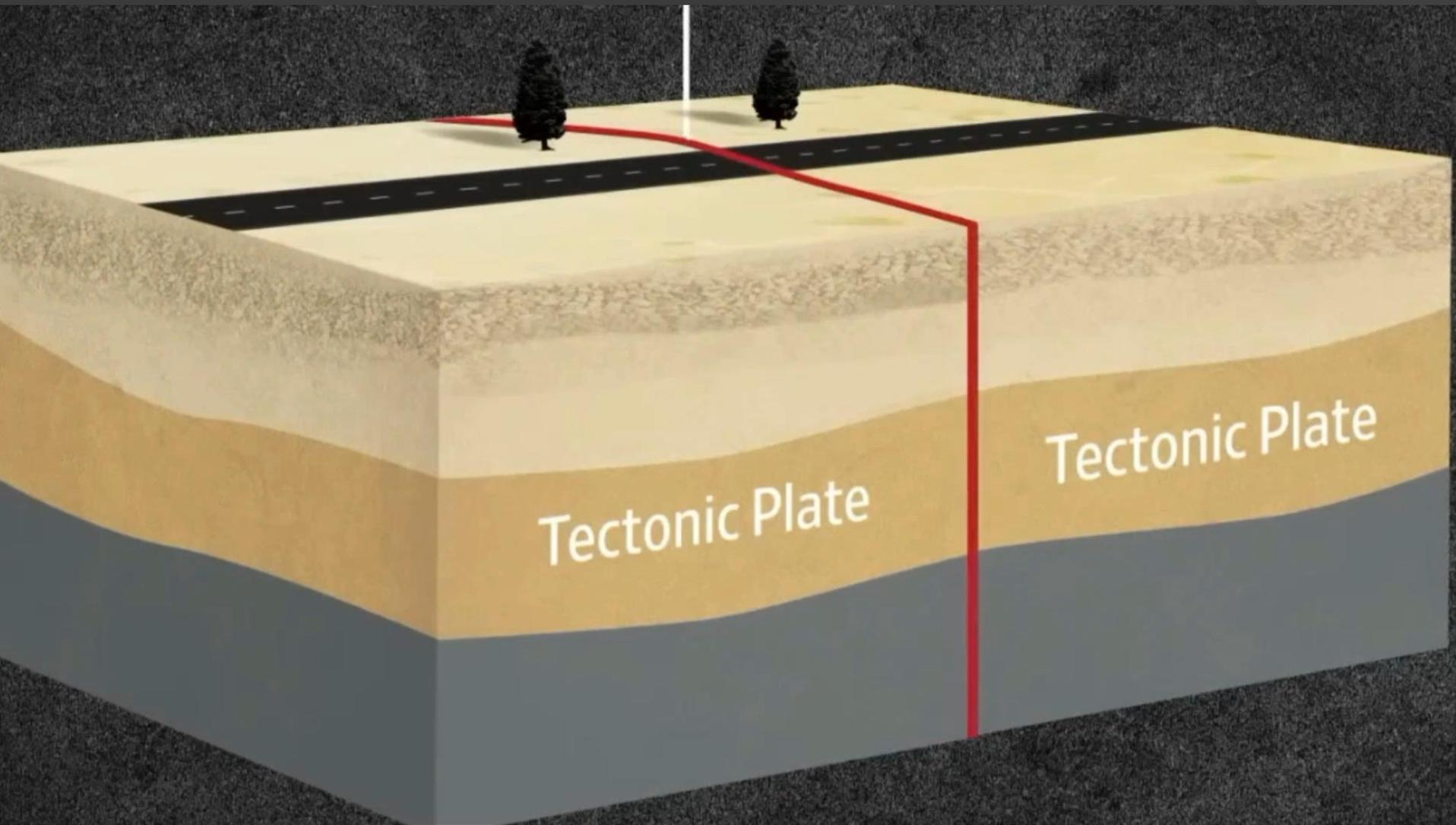
Source: Hasterok et al., (Earth-Sci. Rev., 2022)





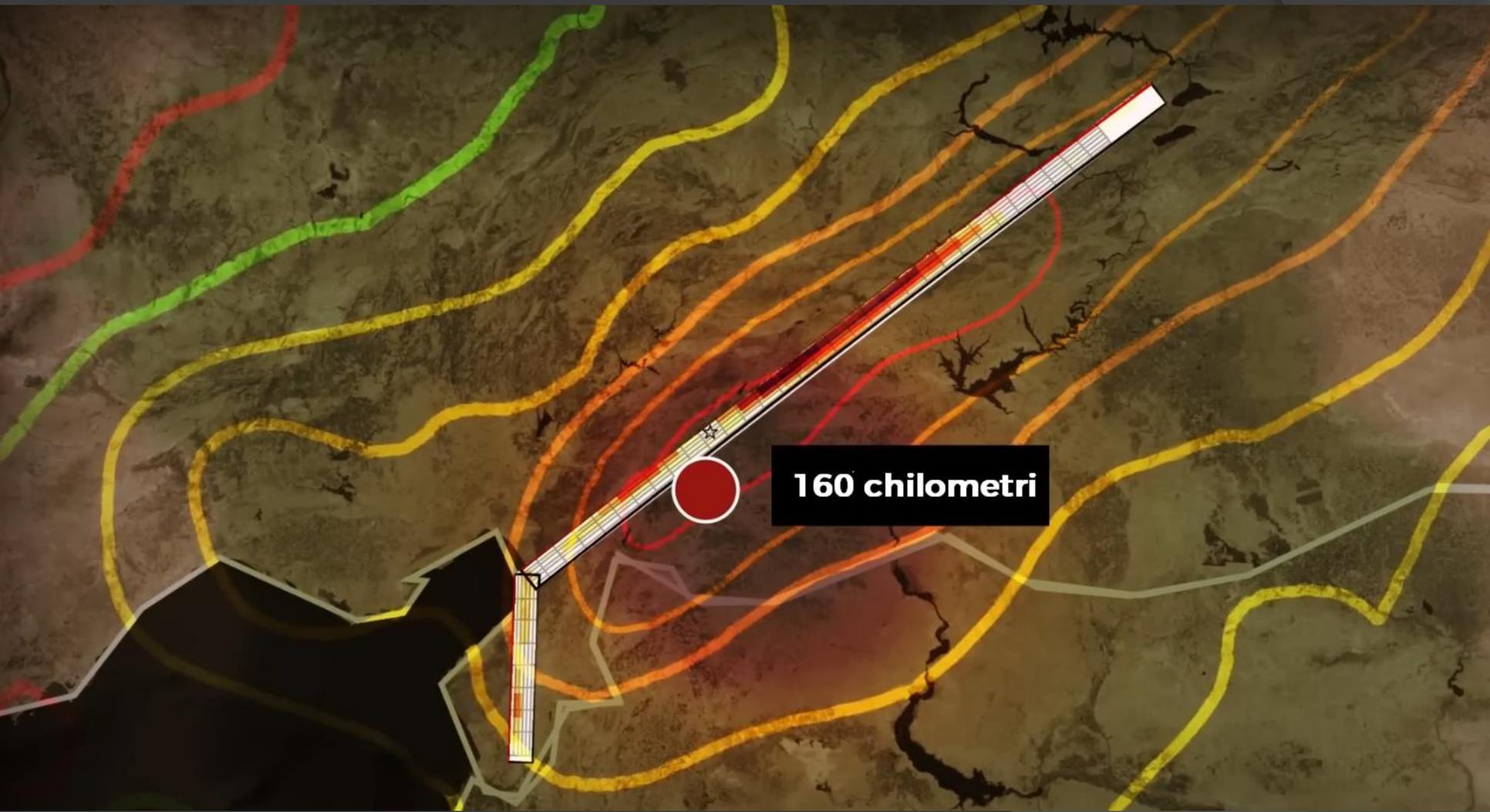


Seismic coupling coefficient =
rapporto tra i tassi deformativi geodetici e quelli sismici



Tectonic Plate

Tectonic Plate



160 chilometri

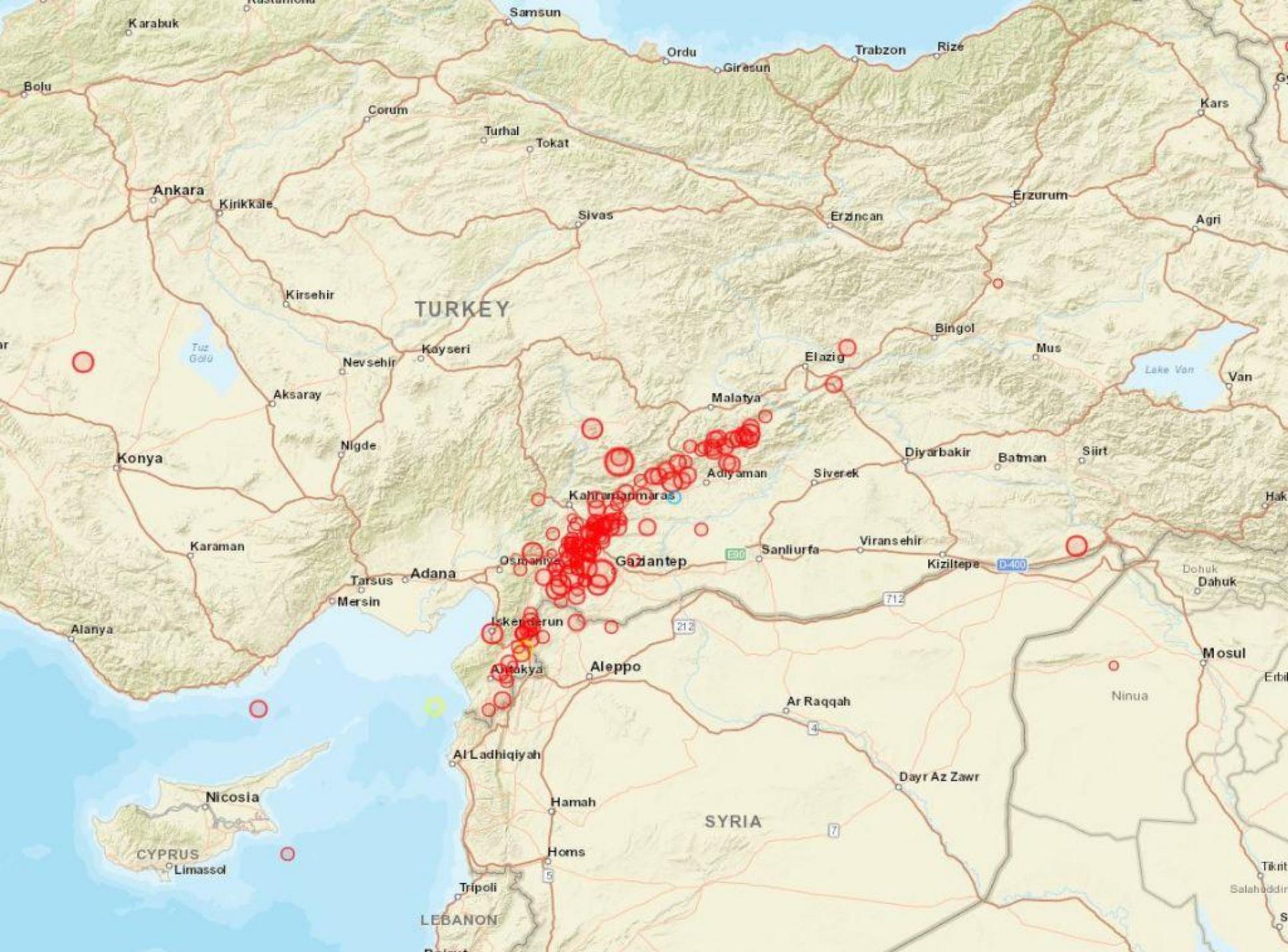


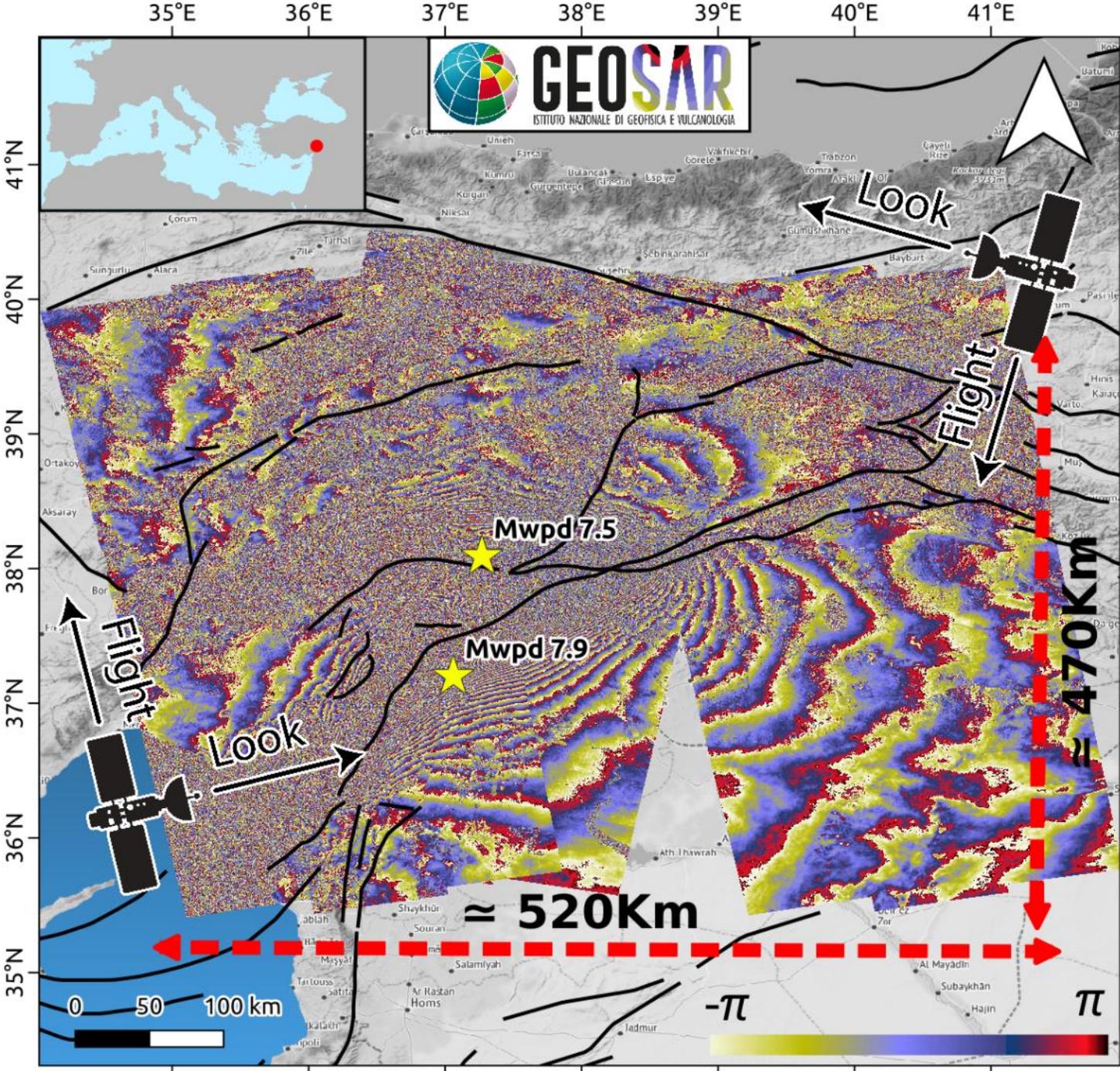




**PRINCETON
UNIVERSITY**

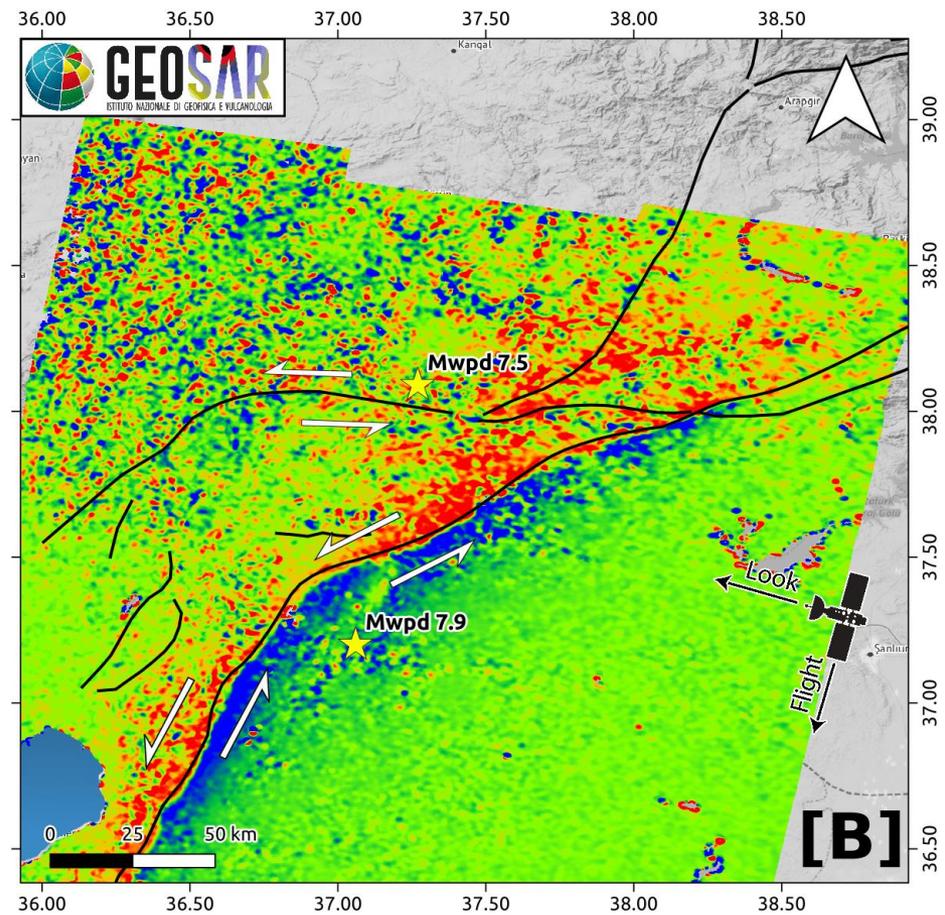
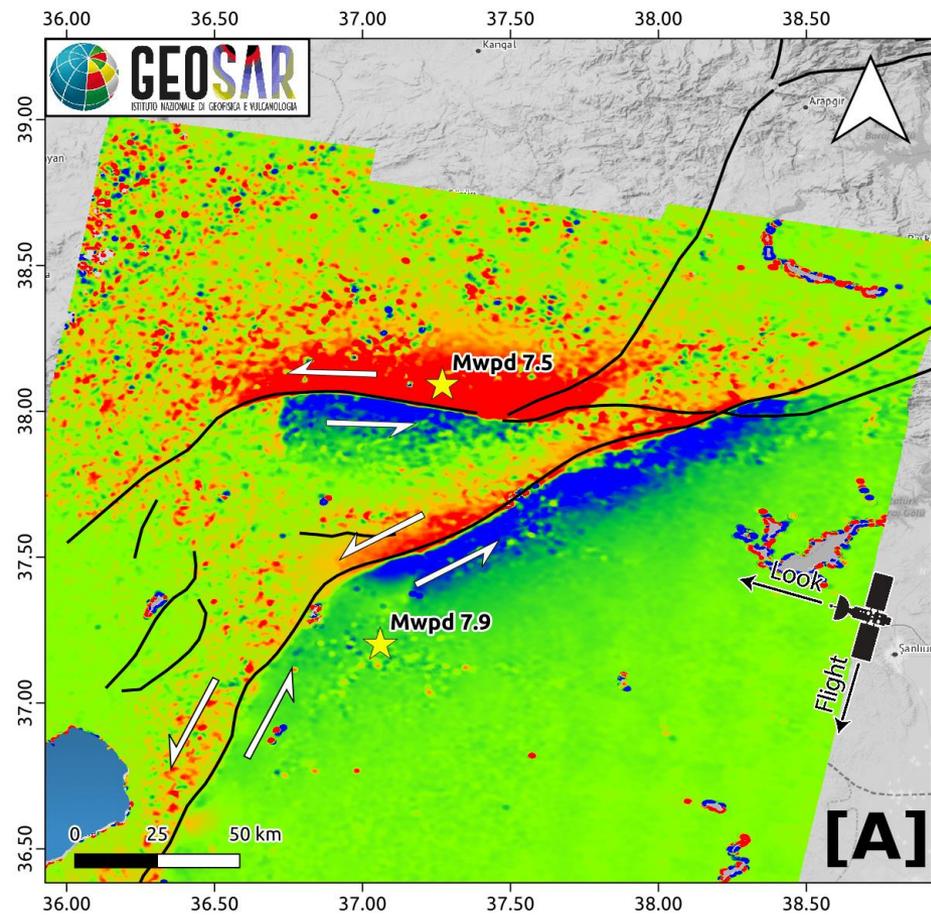
0:00:00





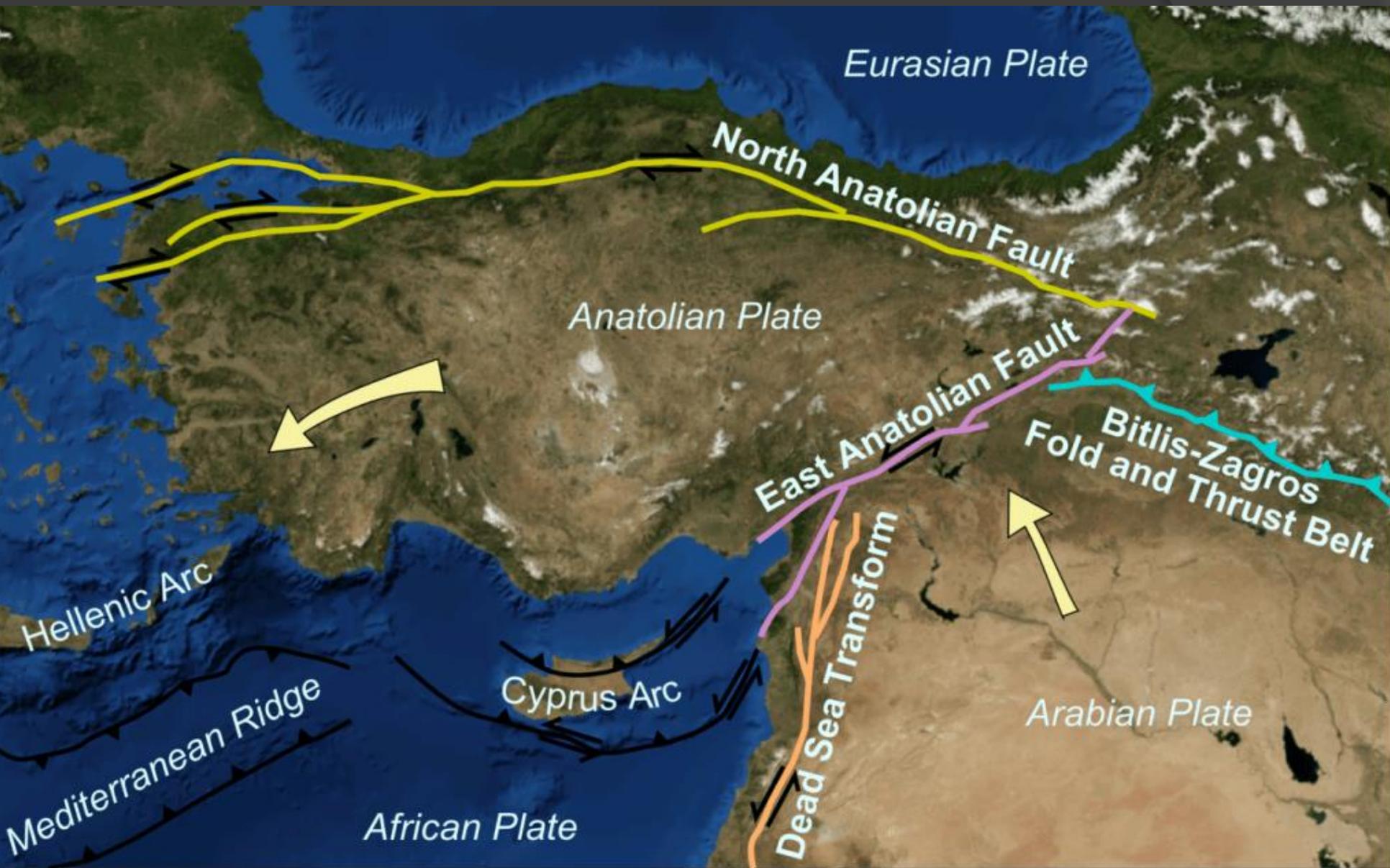
**Ogni
frangia è
uguale a
2,5 cm**

**Spostamenti
superiori
a 2 metri**

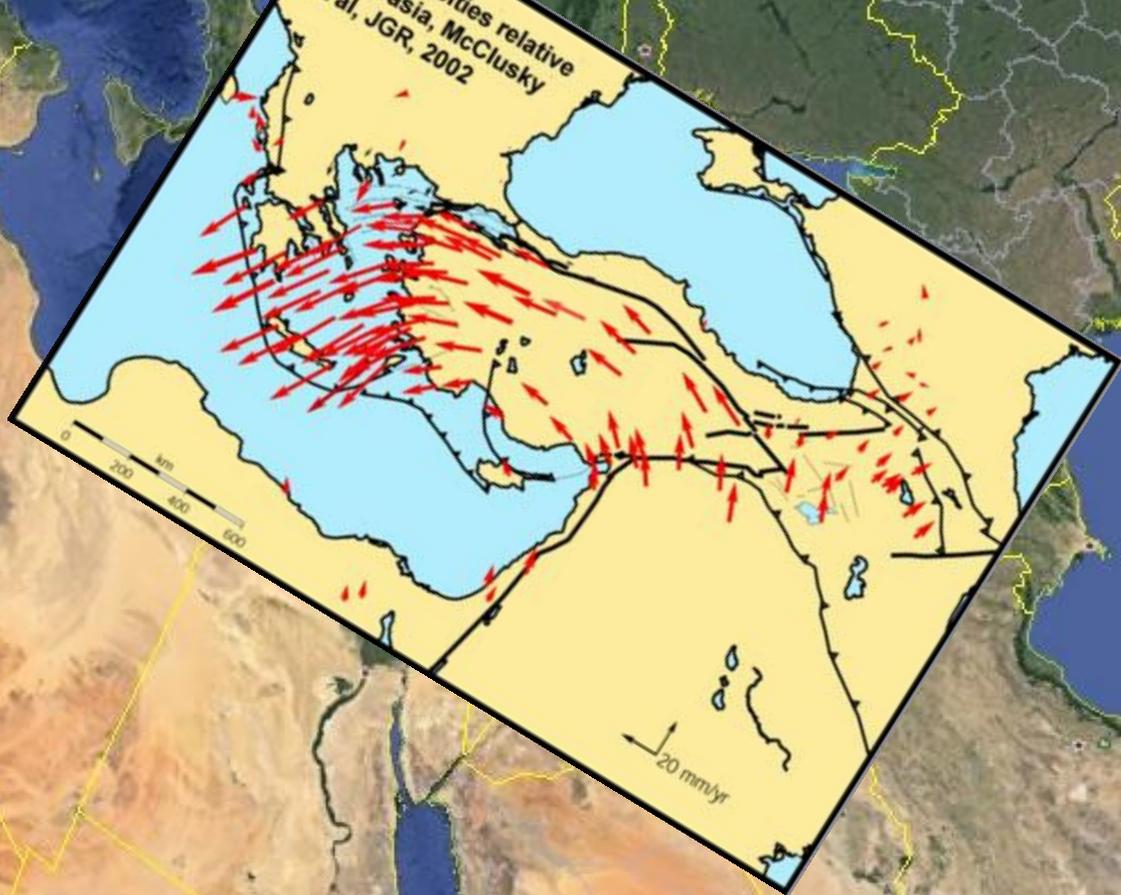


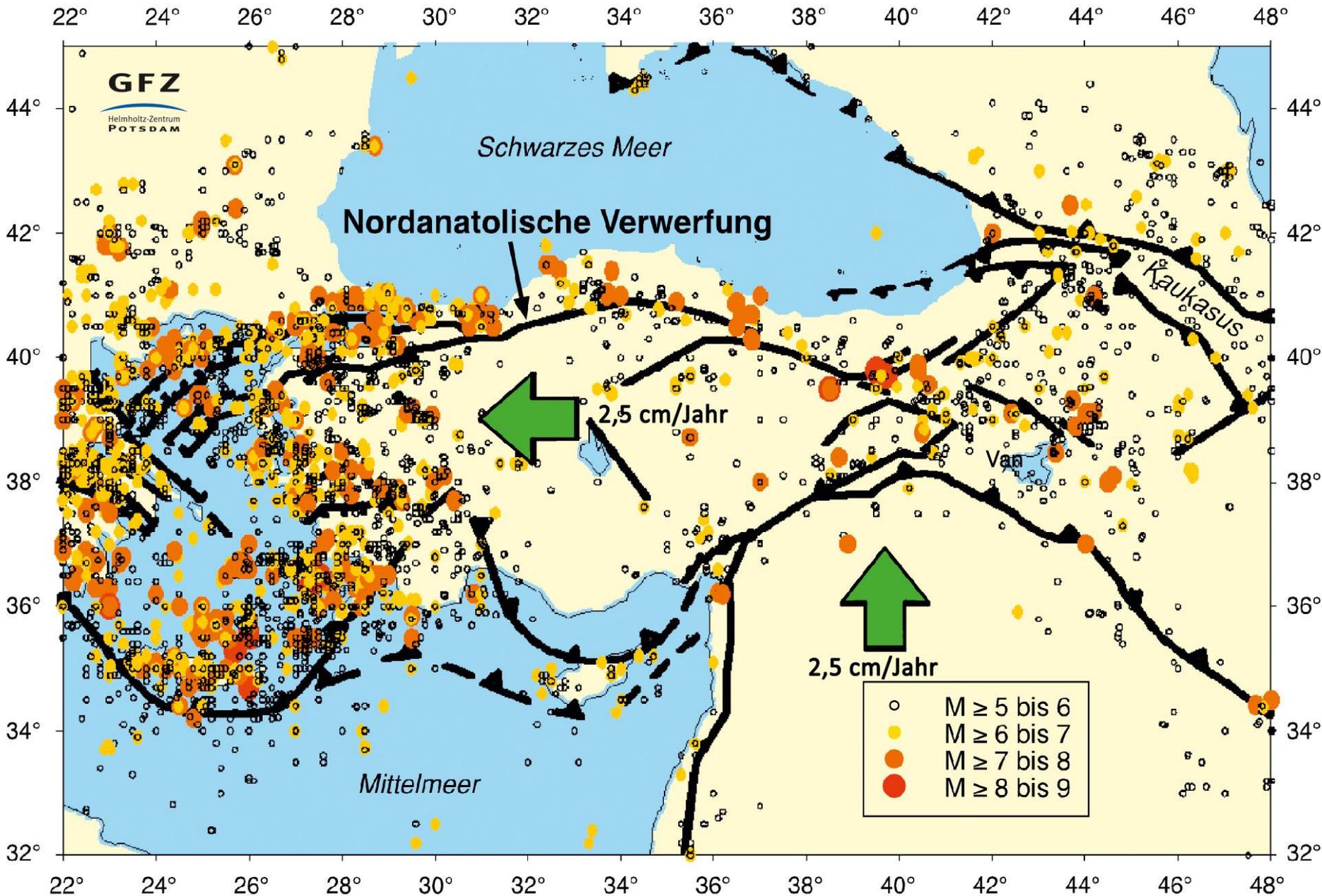
<-2m

>2m

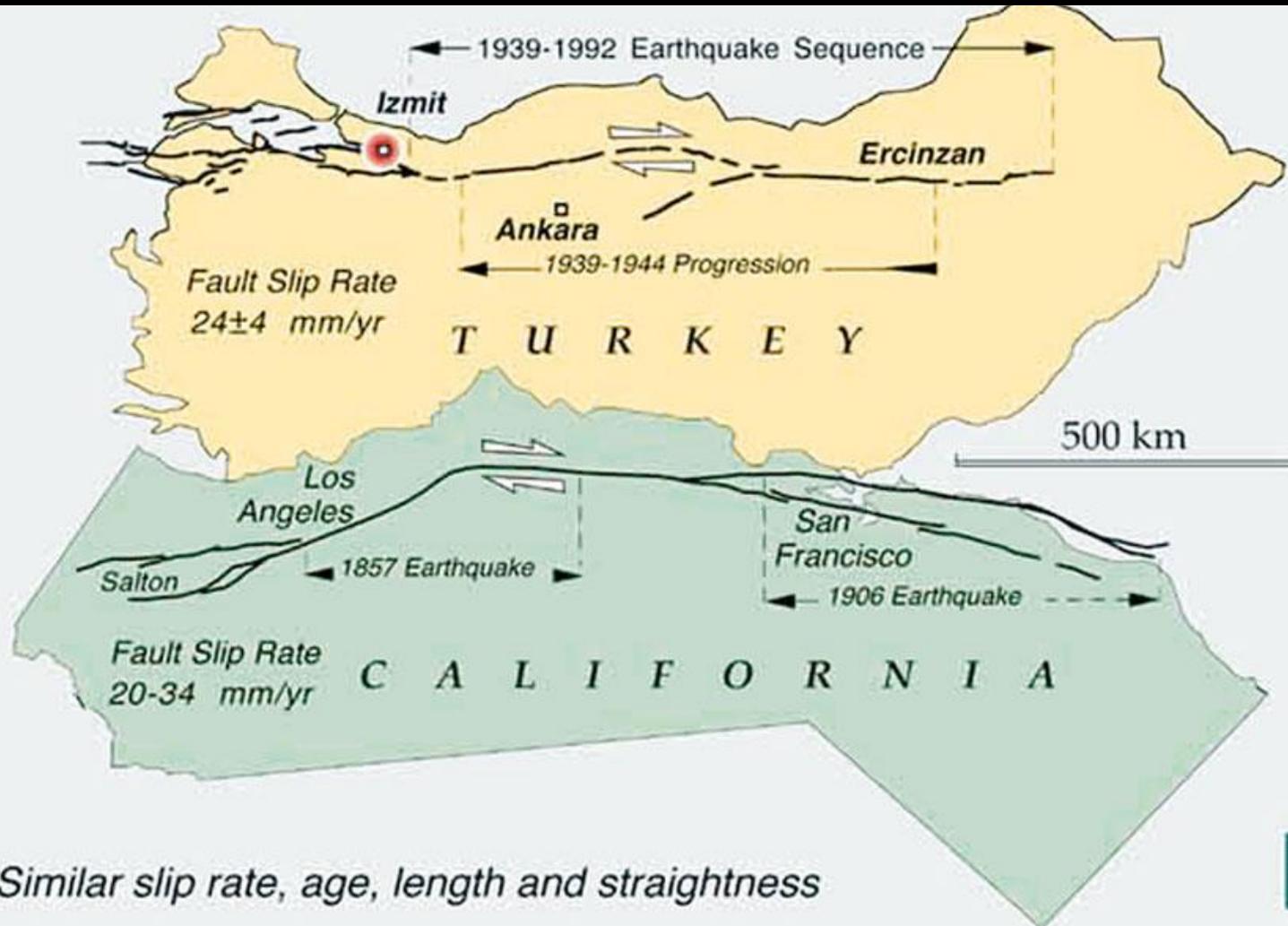


GPS velocities relative
to Eurasia, McClusky
et al, JGR, 2002



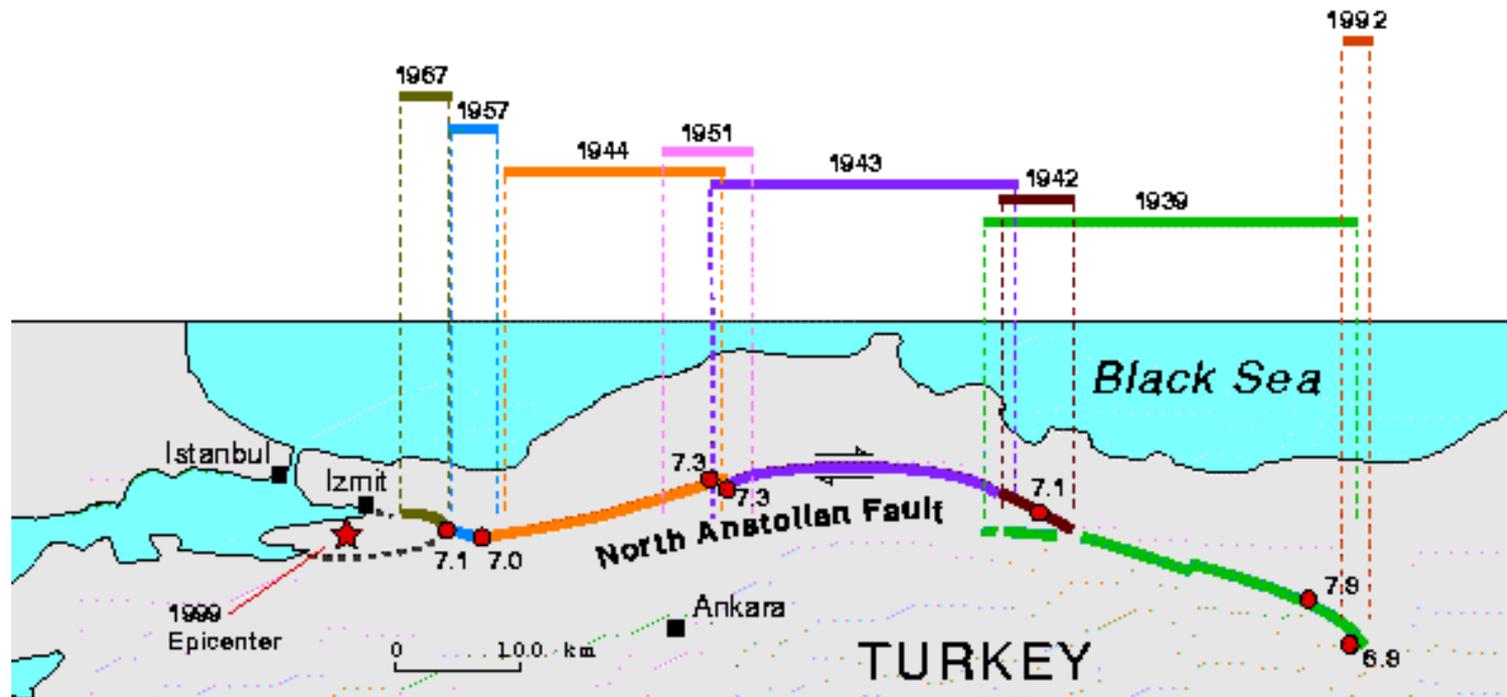


Confronto faglia anatolica Faglia San Andreas



- *Similar slip rate, age, length and straightness*

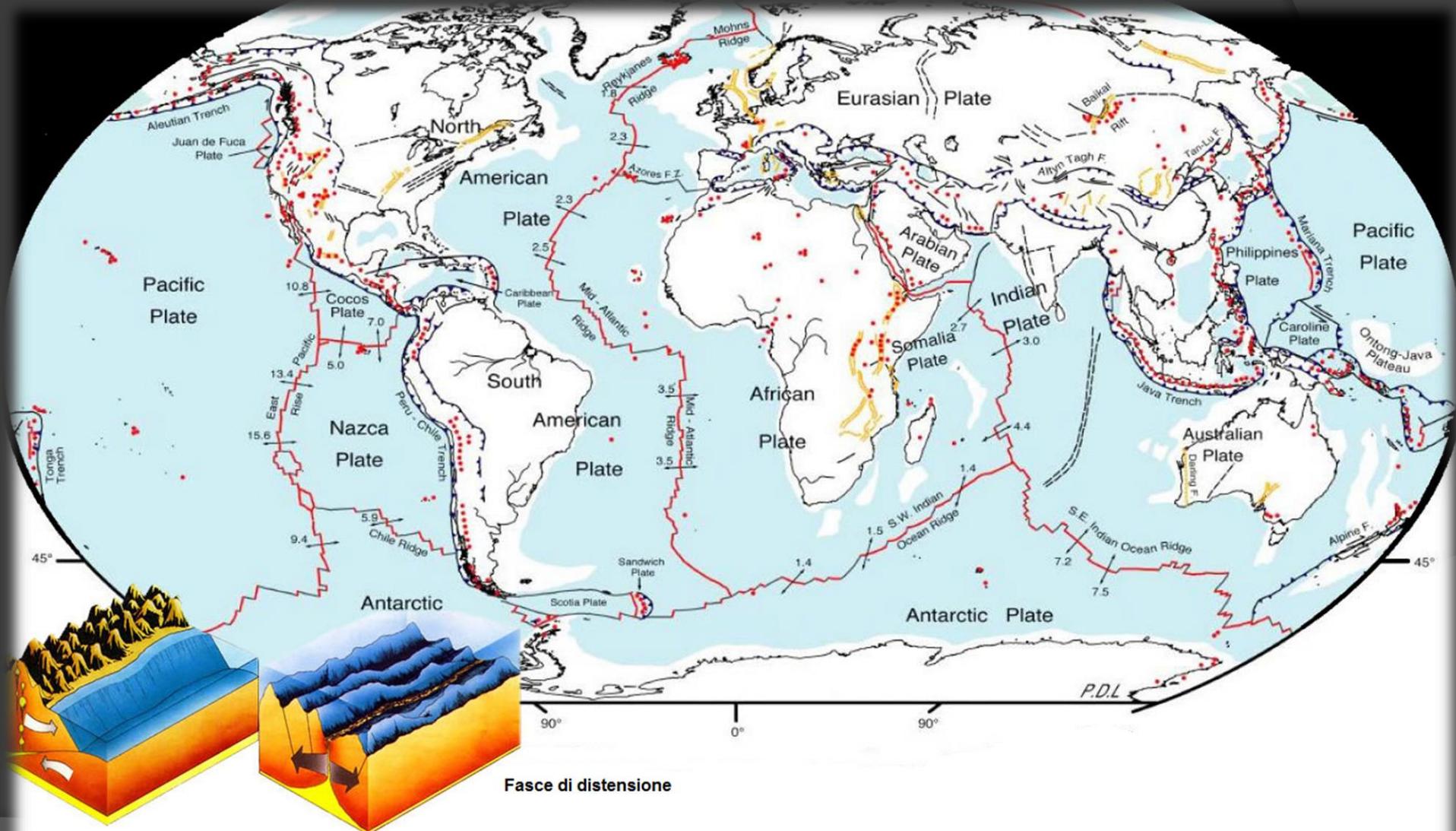
Location of August 17, 1999 Turkish Earthquake



- Historical earthquake epicenter and magnitude
- 1957 Extent of surface rupture
- ⇄ Directions of relative motion on fault

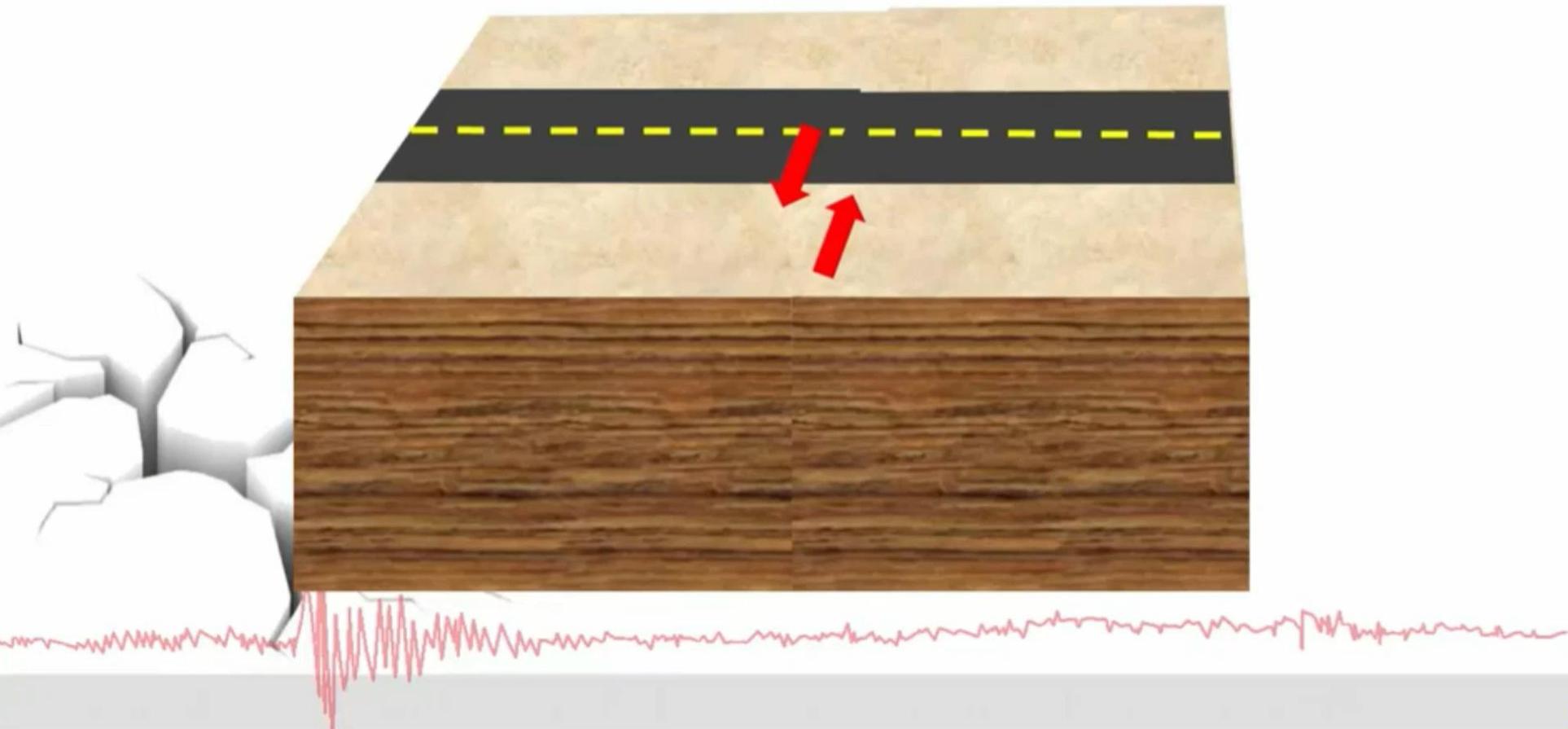
**Dove altre situazioni simili nel
resto del Pianeta?**

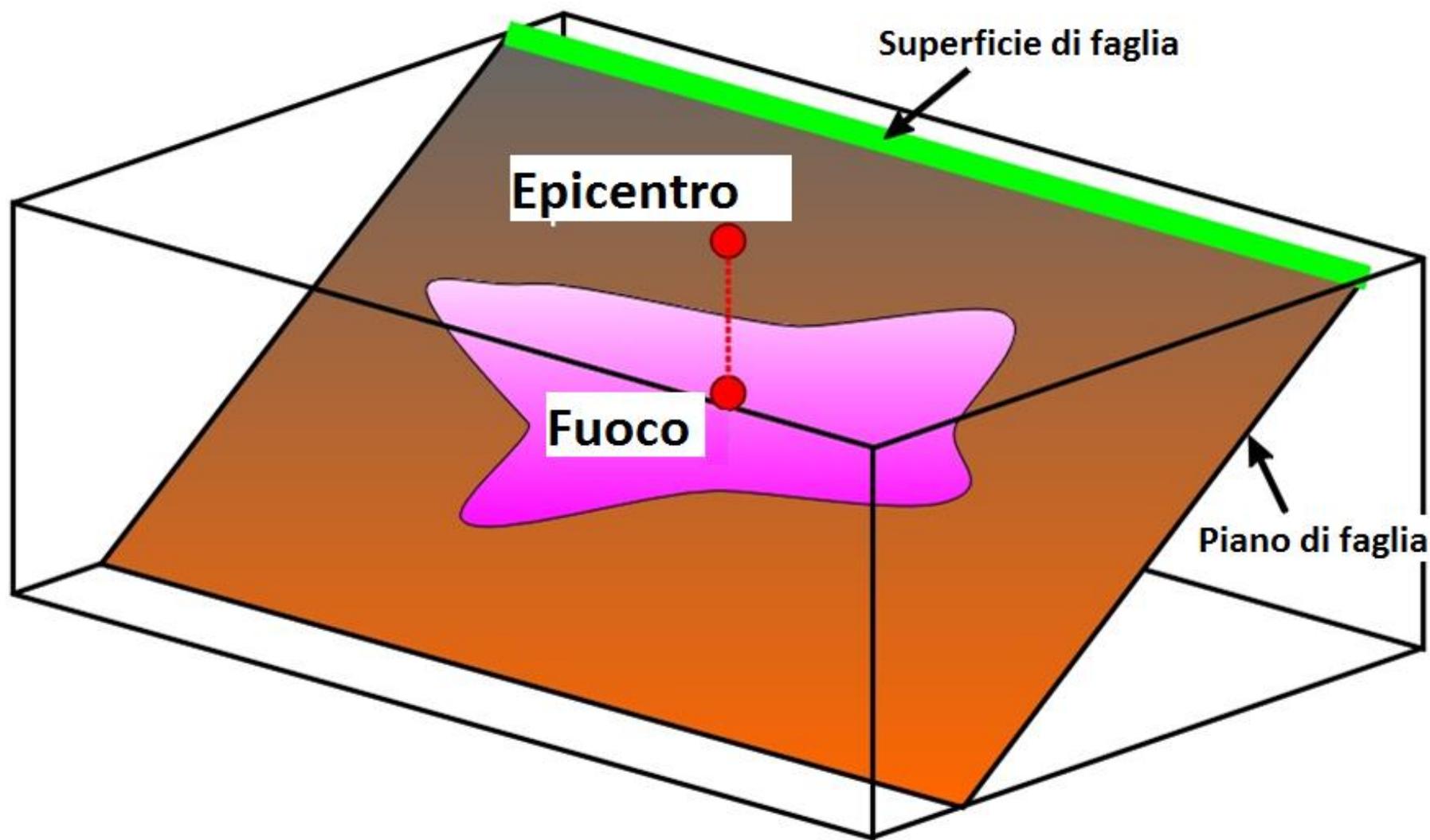
Ovunque ci sono margini tra placche...



Fasce di convergenza

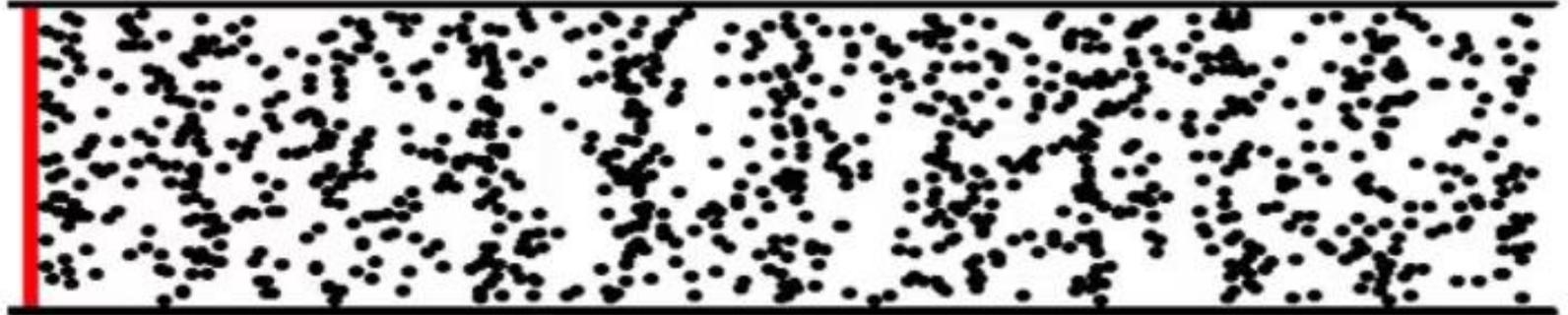
Fasce di distensione





Tipi di onde

Onde P (Primarie)



Onde S (secondarie)



April 25
Magnitude 7.8

May 12
Magnitude 7.3

Nepal

AND

ach Kande

lly

TTAR
ADESH

SIKK

Dir
दिन

Pithoragarh

Katti

Lakhimpur

Bahraich

Lucknow

Kanpur

Raebareli

Faizabad

Gorakhpur

Deoria

Jaunpur

Bharatpur
भरतपुर

Kathmandu
काठमाडौं

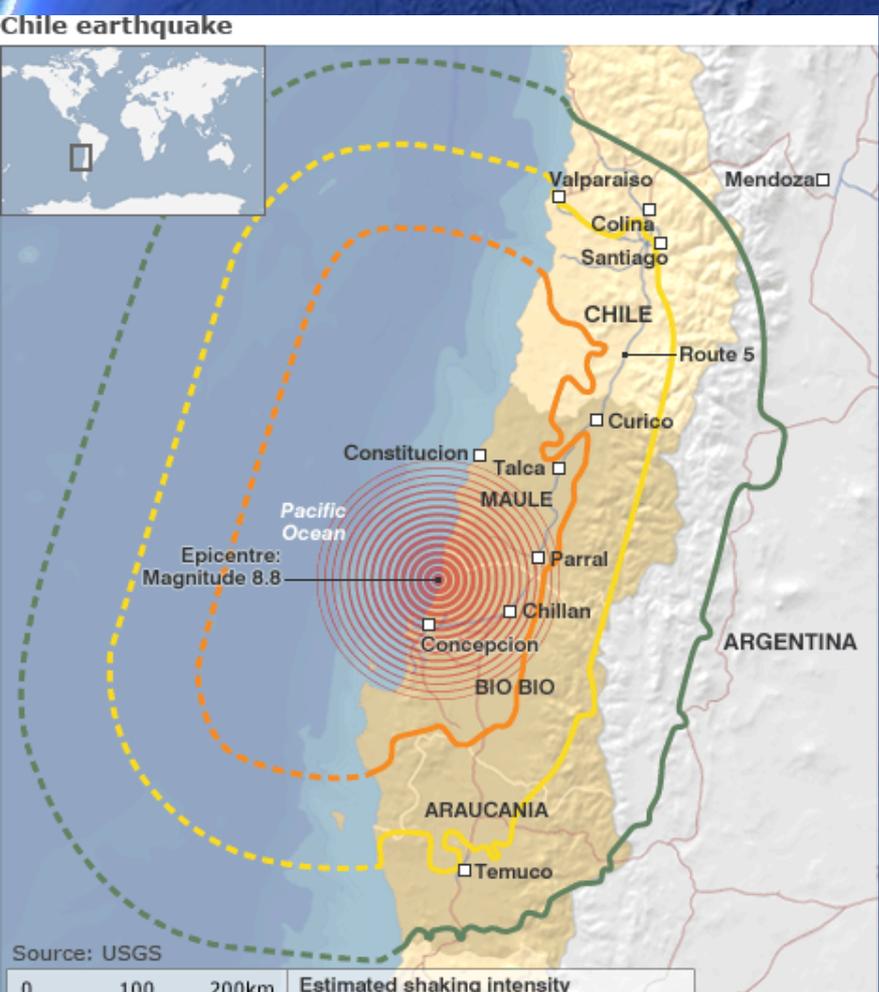
Darbhanga

Biratnagar
विराटनगर

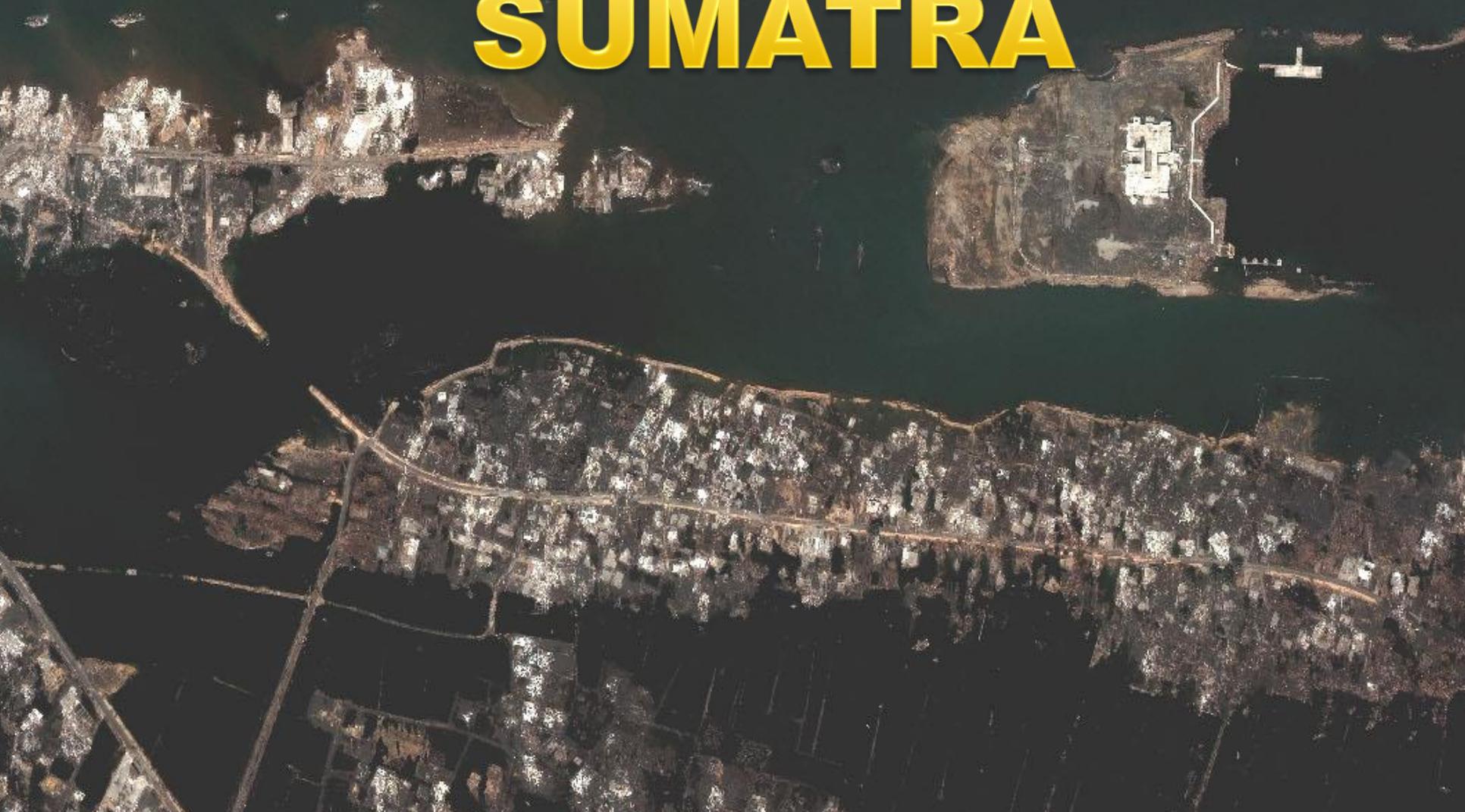
Patna

BIHAR

Anno 2010: Cile Terremoto M 8.8 507 morti

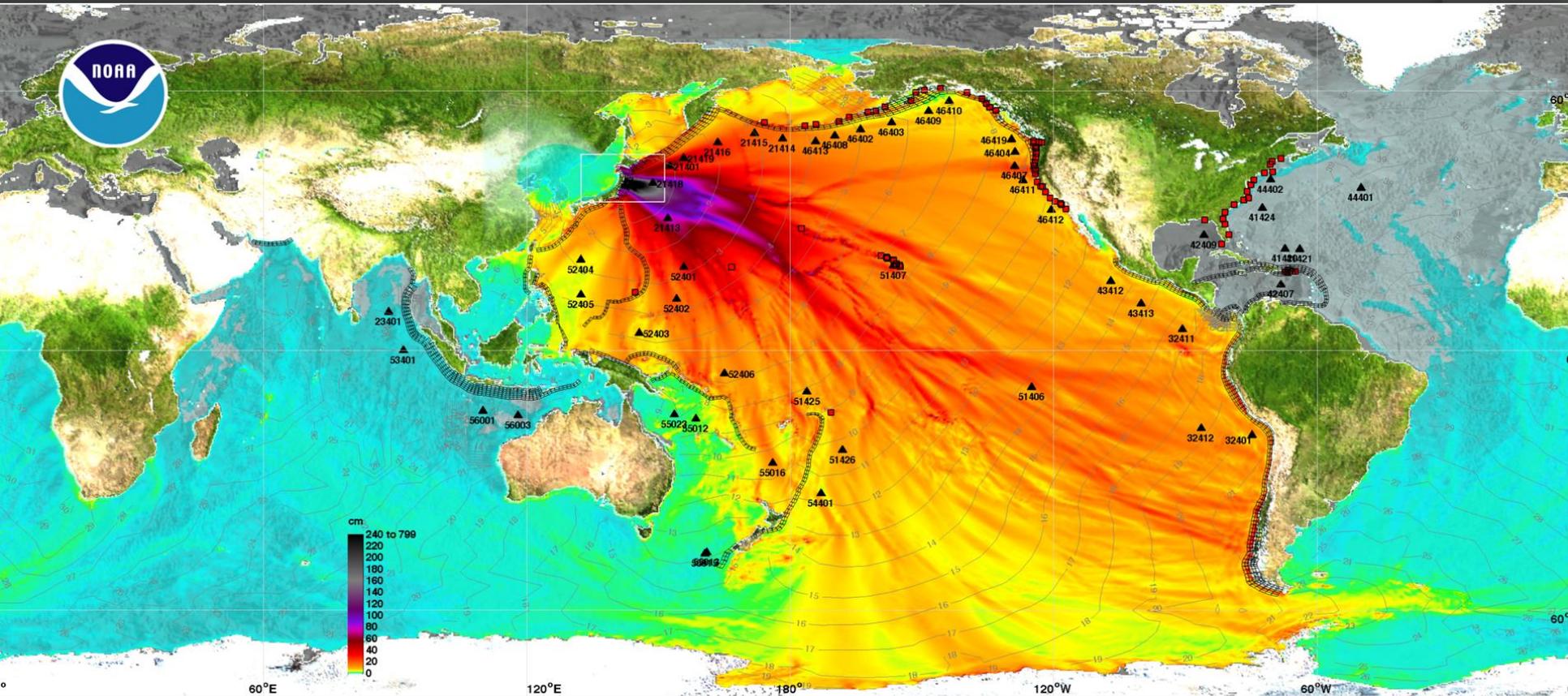


26 dicembre 2004
SUMATRA



11 marzo 2011

GIAPPONE



Concentriamoci sul Mediterraneo

La dashboard della sismicità del 2022

numero eventi

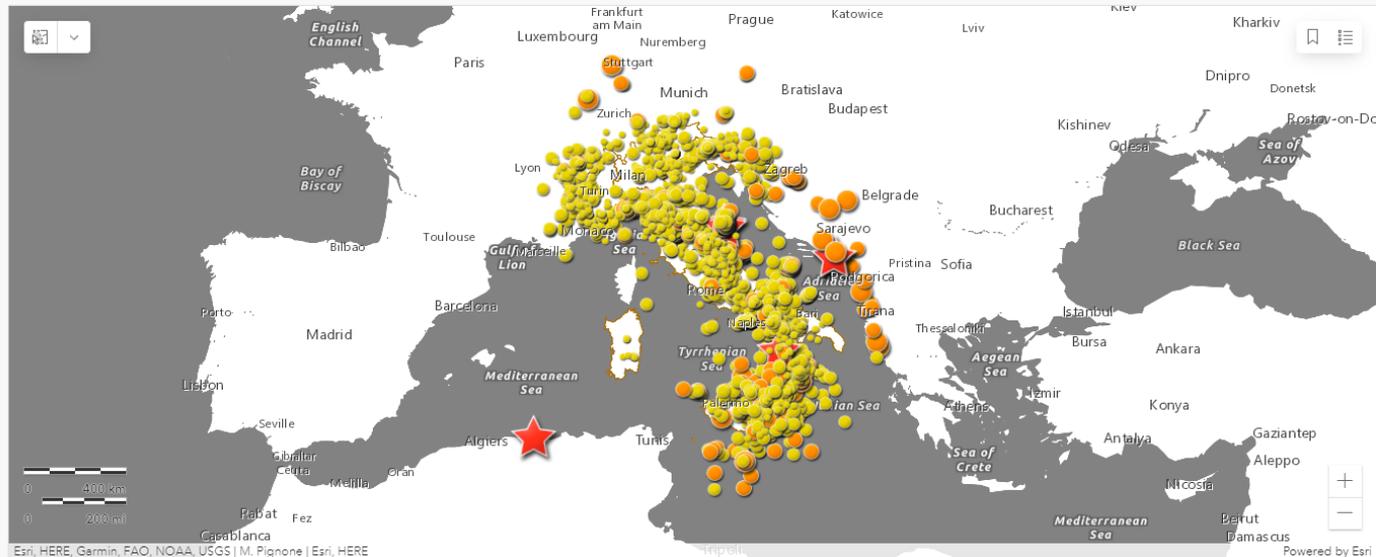
magnitudo massima

 **16302**



lista eventi magnitudo maggiore

-  Mw 5,5, 2022-04-22, Bosnia and Herz, [Land]
-  Mw 5,5, 2022-11-09, Costa Marchigiana Pesarese (Pesaro-Urbino)
-  Mw 5,4, 2022-10-31, Golfo di Policastro (Salerno, Potenza)
-  ML 5,2, 2022-11-09, Costa Marchigiana Anconetana (Ancona)
-  mb 5,1, 2022-03-19, Northern Algeria [Sea: Algeria]
-  ML 5,1, 2022-04-24, Bosnia and Herz, [Land]
-  mb 4,8, 2022-06-30, Bosnia and Herz, [Land]

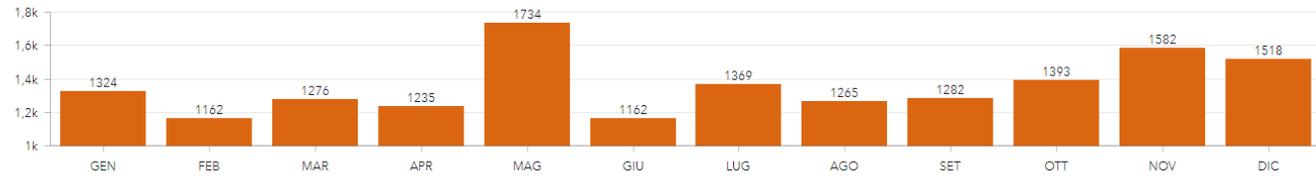


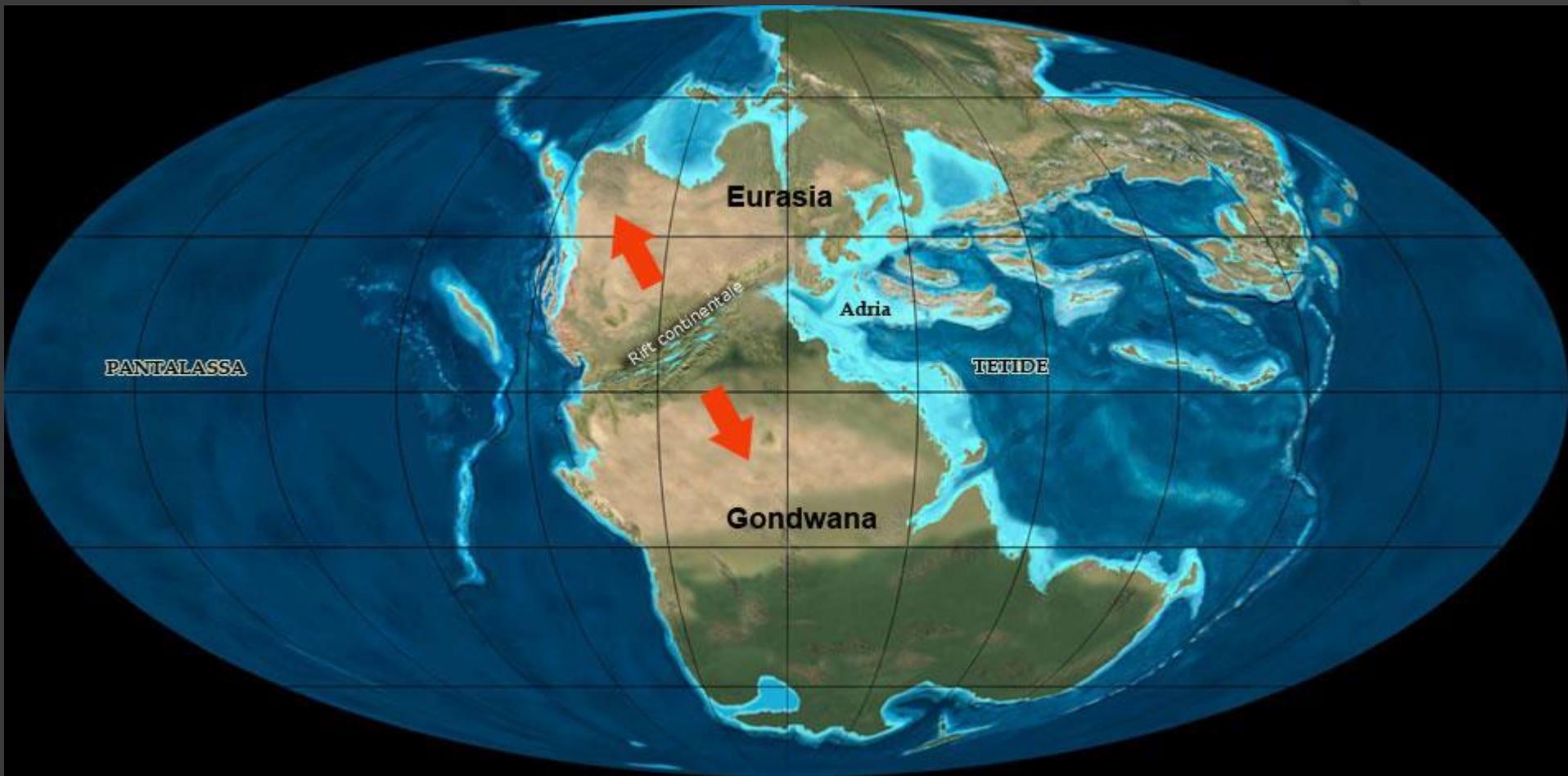
classi di magnitudo



-  M < 2,0 14k
-  M da 2,0 a 2,9 2k
-  M da 3,0 a 3,9 225
-  M da 4,0 a 4,9 27
-  M da 5,0 a 5,5 6

distribuzione mensile degli eventi



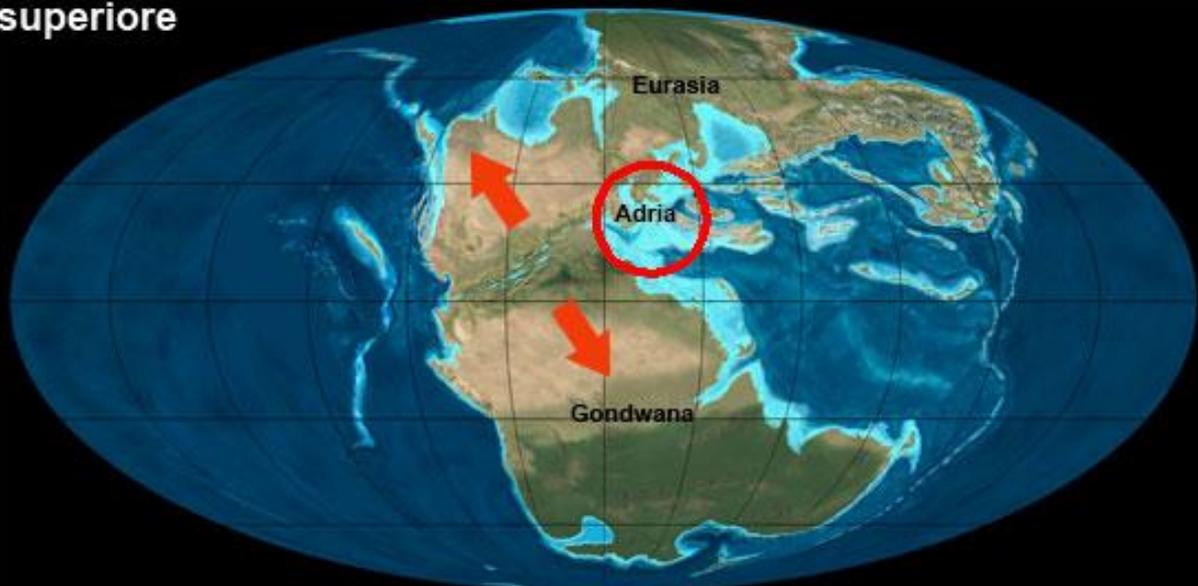


300-250 mil. anni fa
Triassico

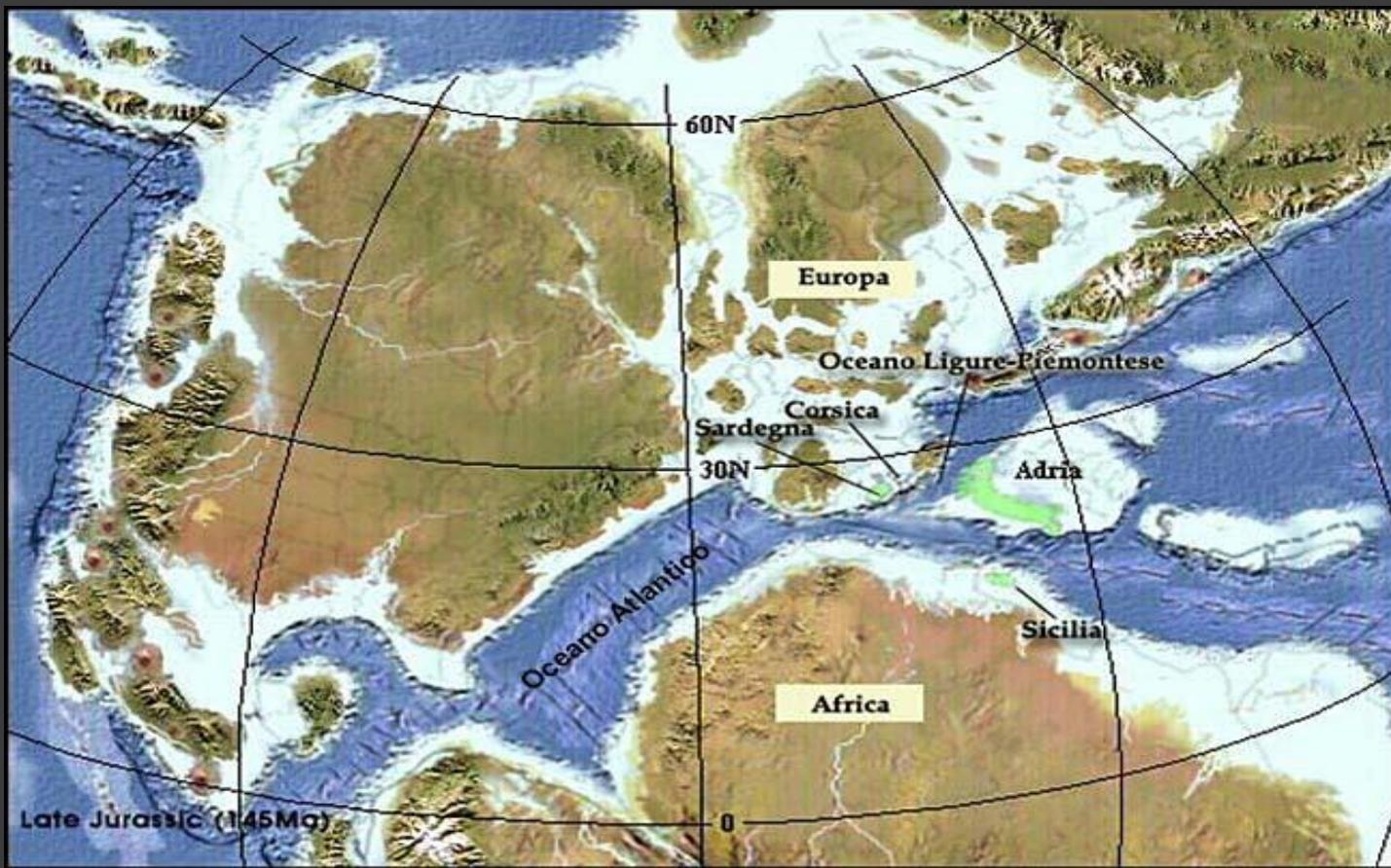
**230 mil. anni fa
Triassico sup**



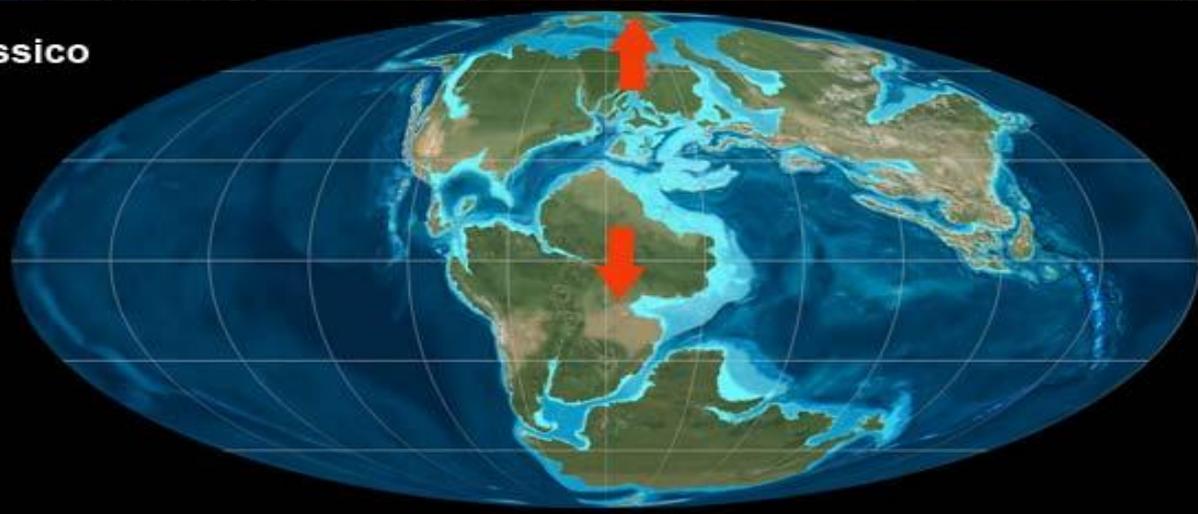
**Triassico superiore
228 Ma**



180 mil. anni fa Giurassico



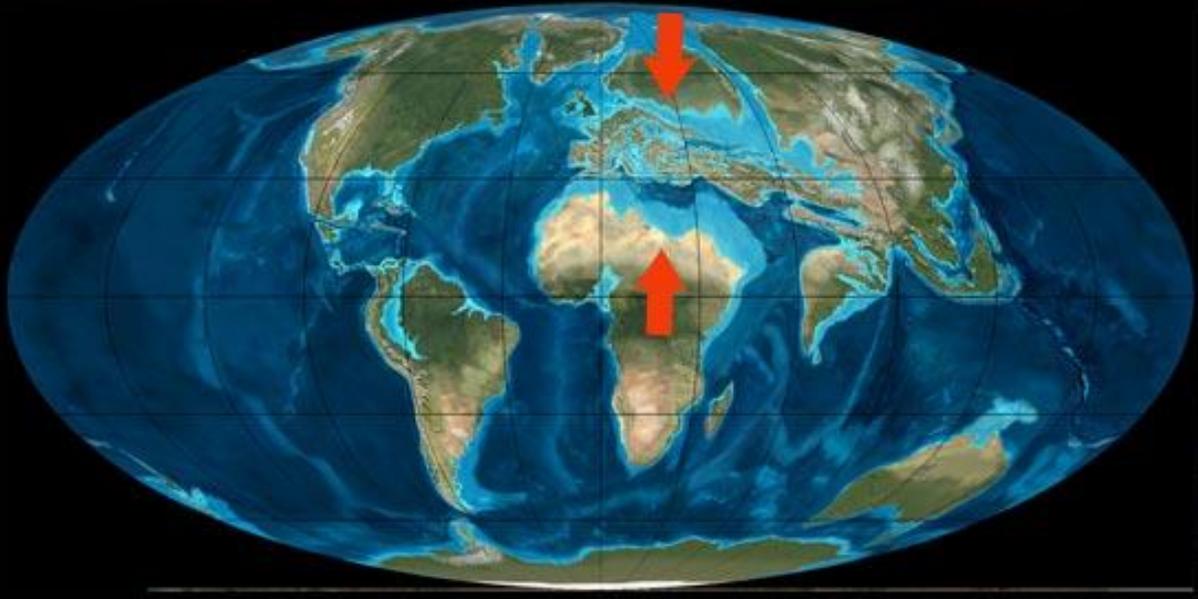
Fine Giurassico
150 Ma



130 mil. anni fa
Cretaceo



Eocene
55 Ma

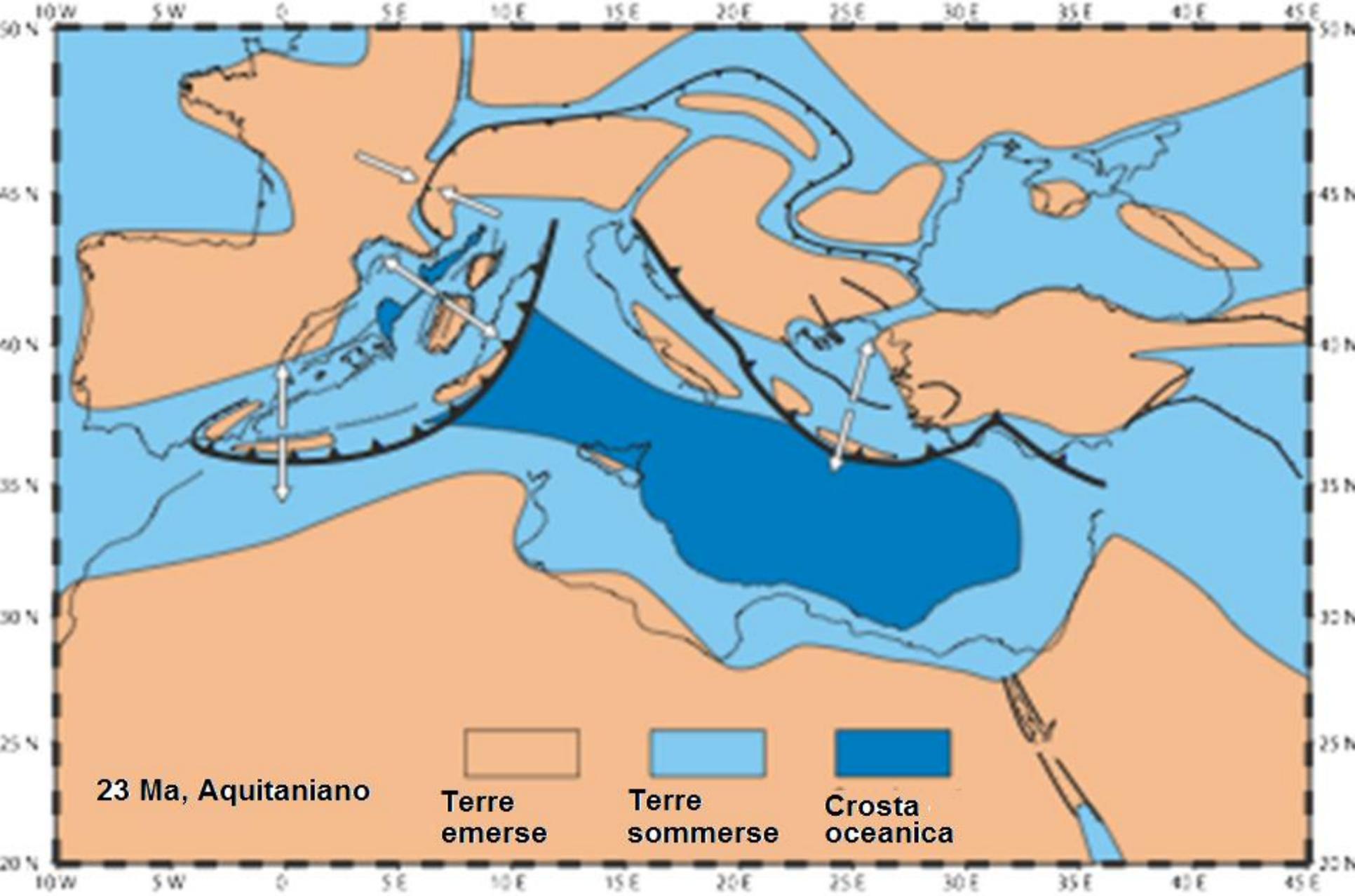


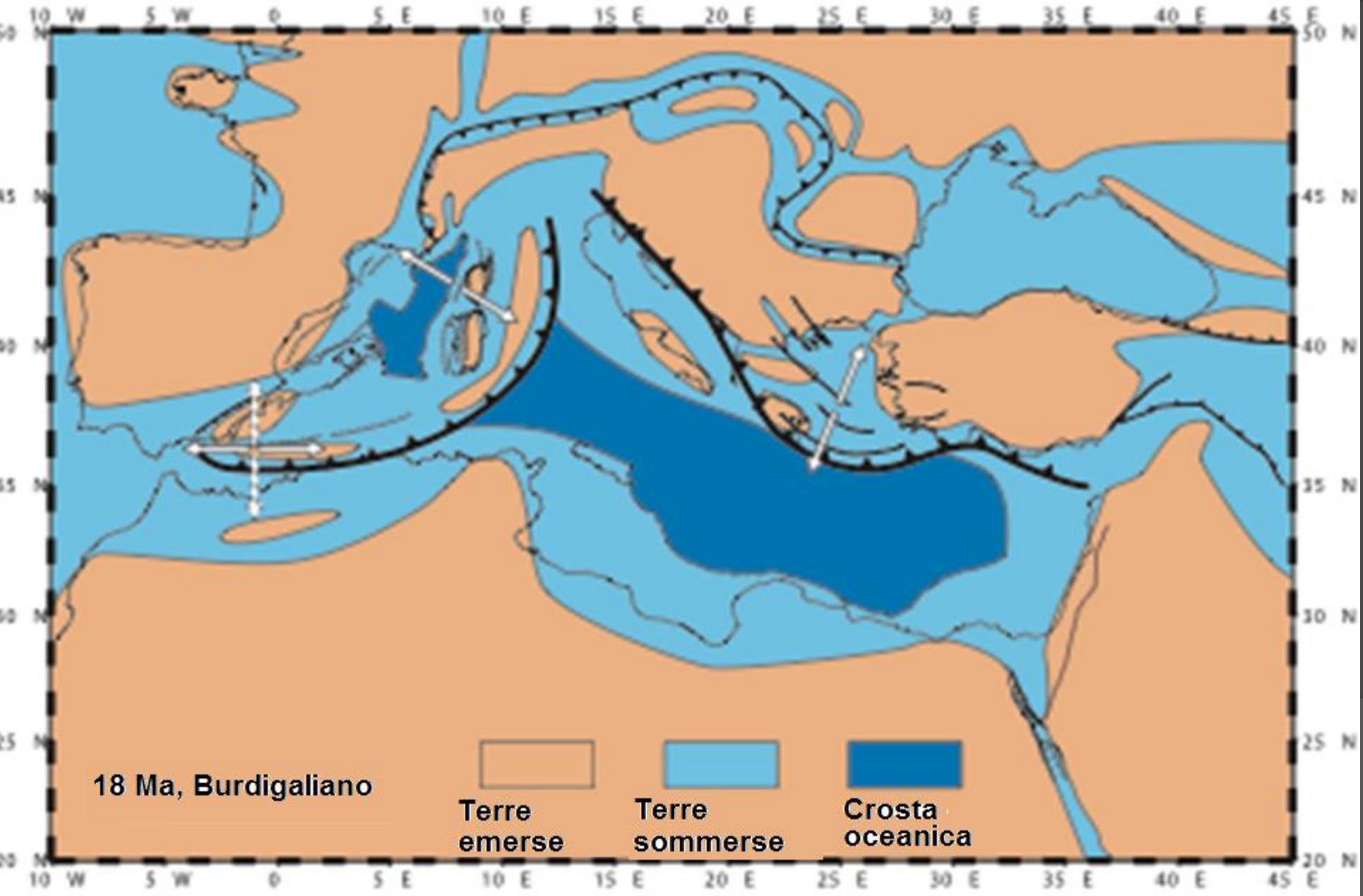
24 mil. anni fa Oligocene-Miocene

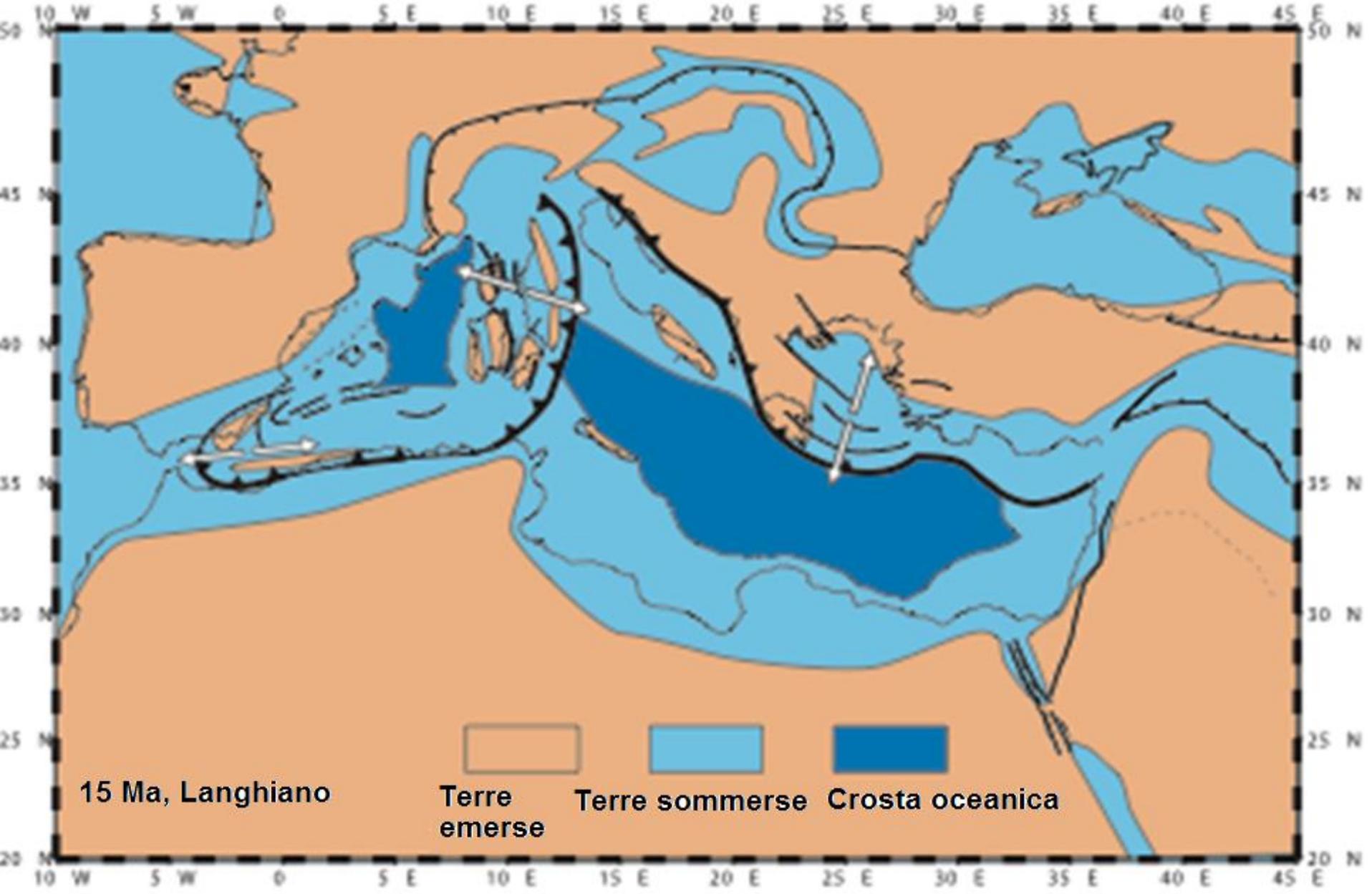


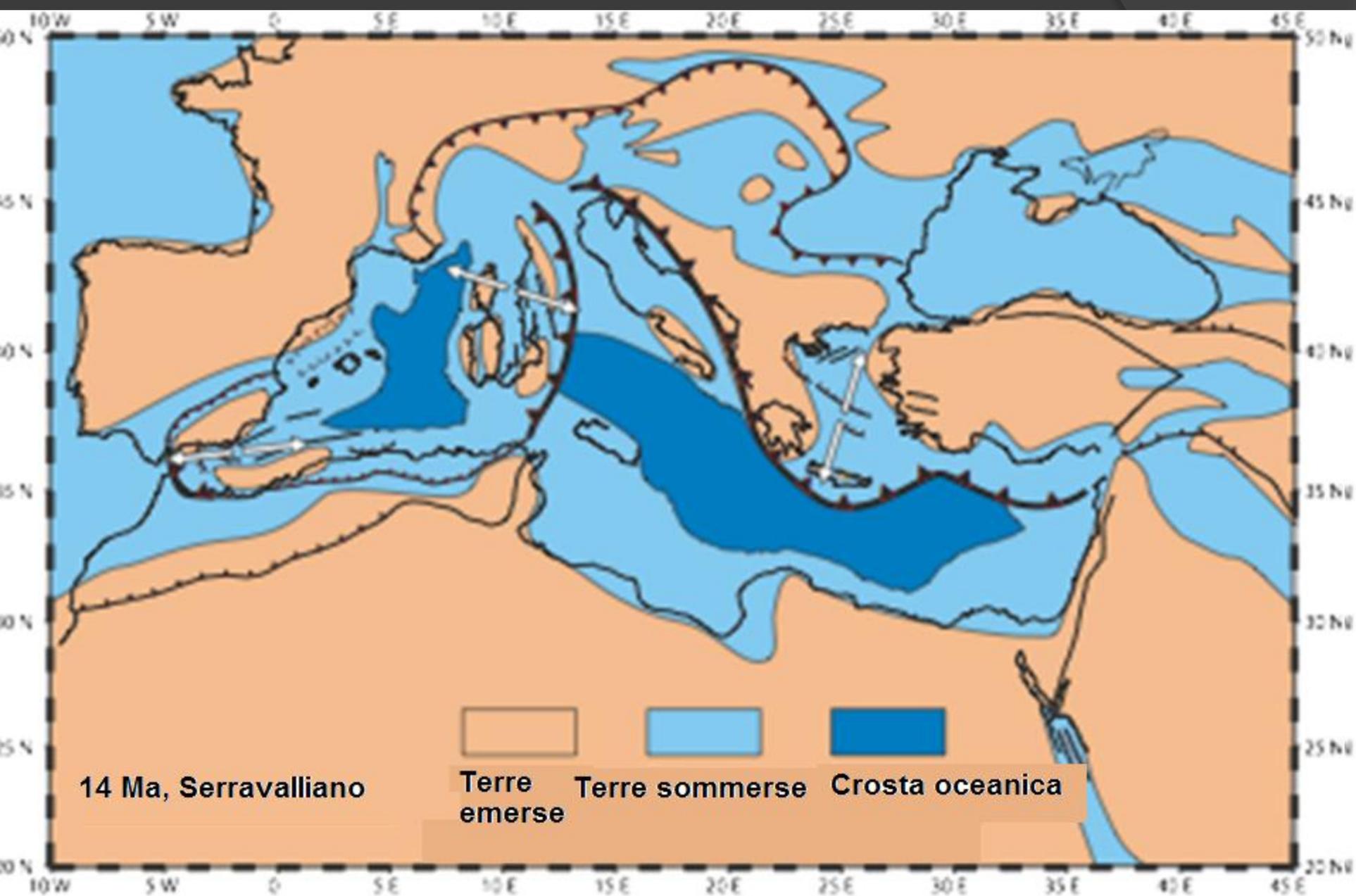
Miocene
23 Ma

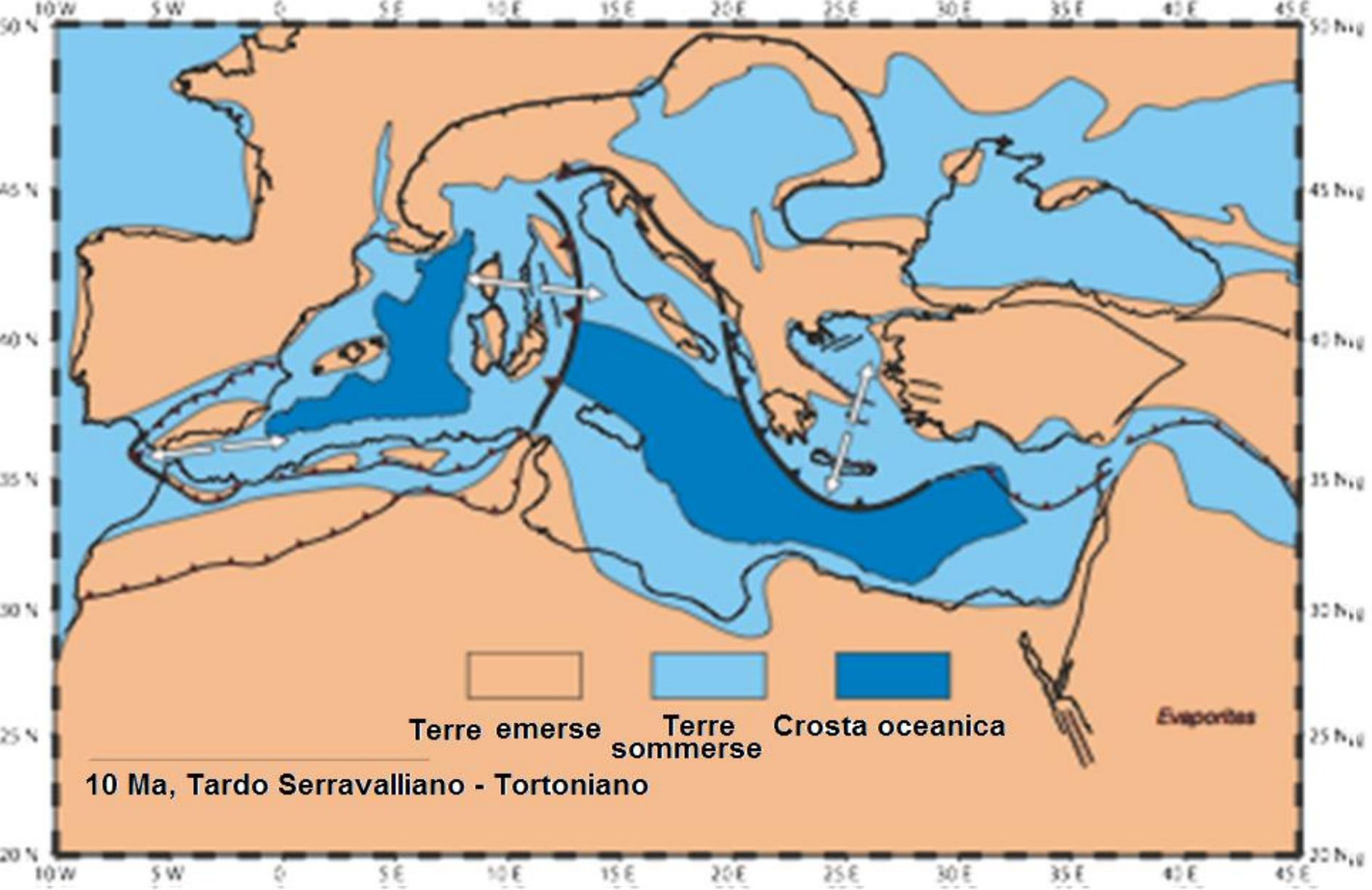


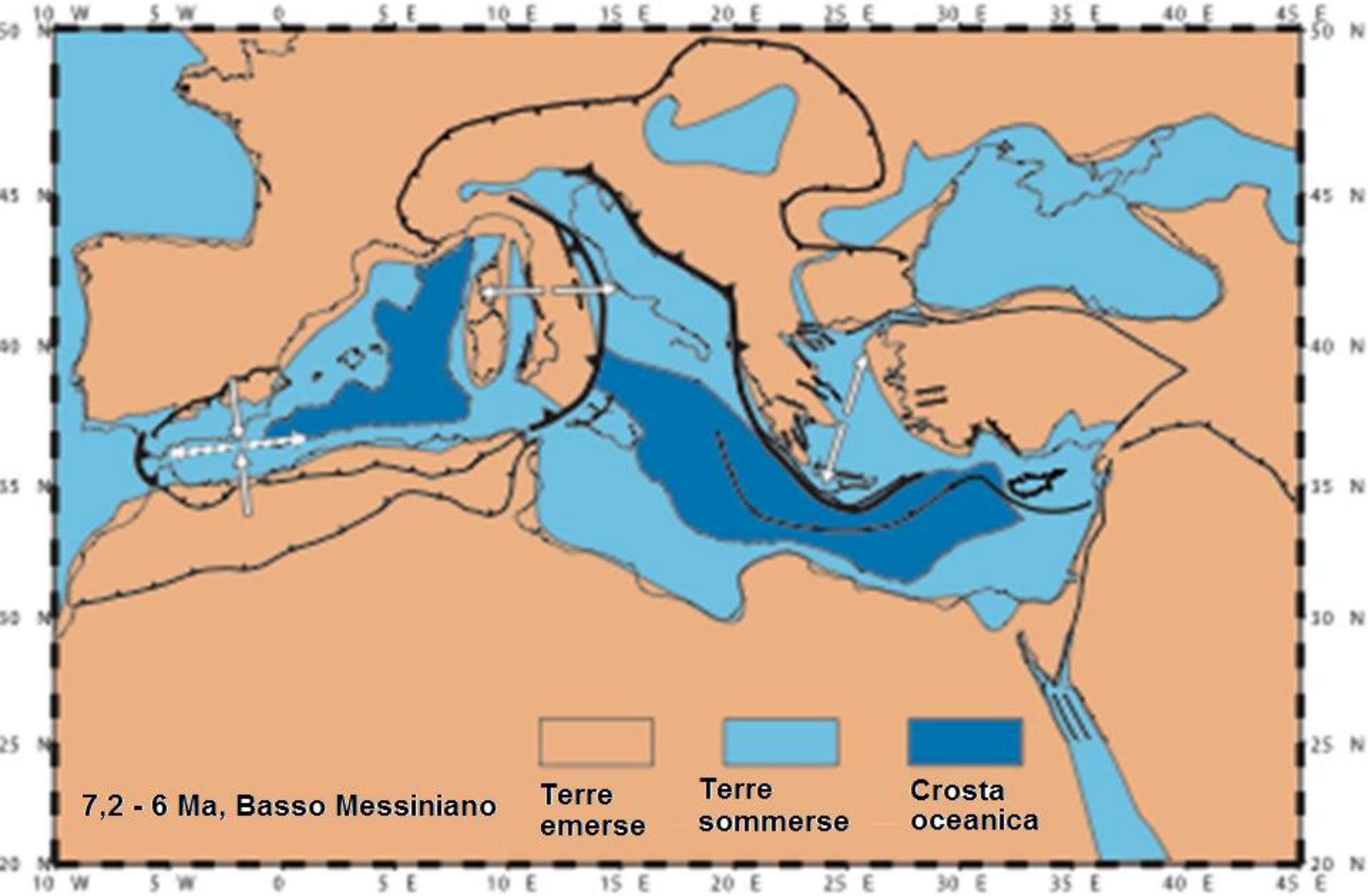


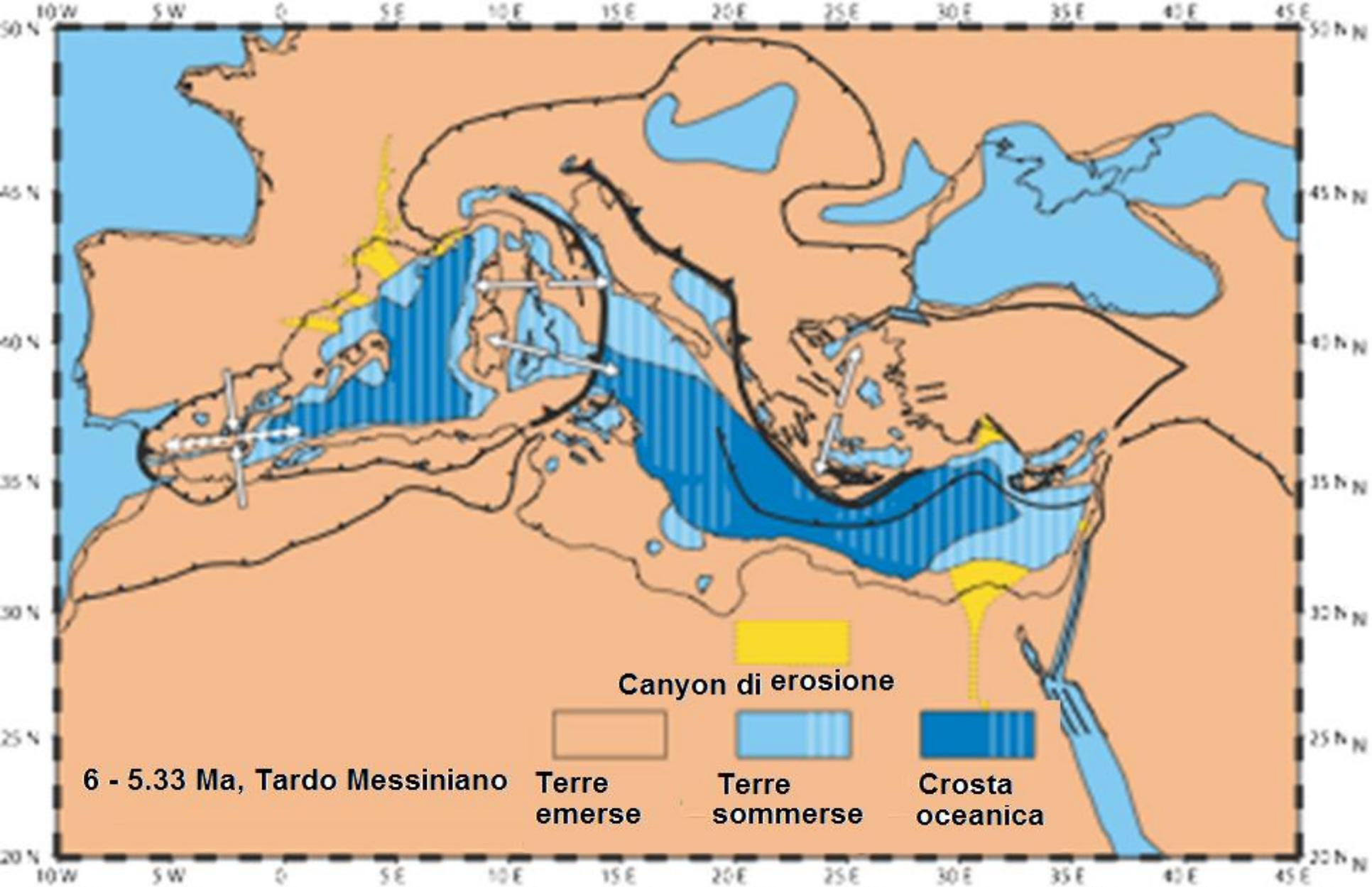


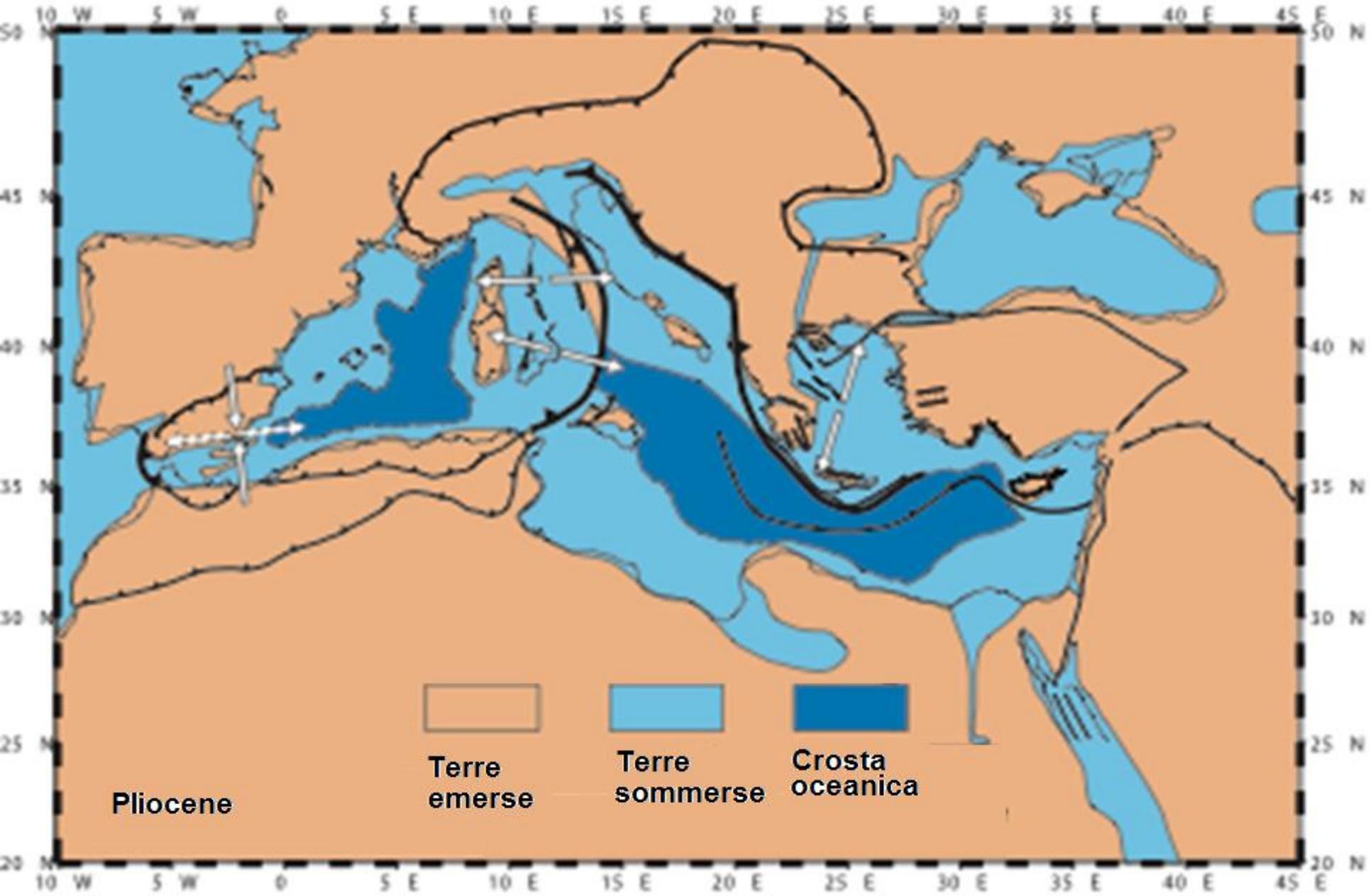


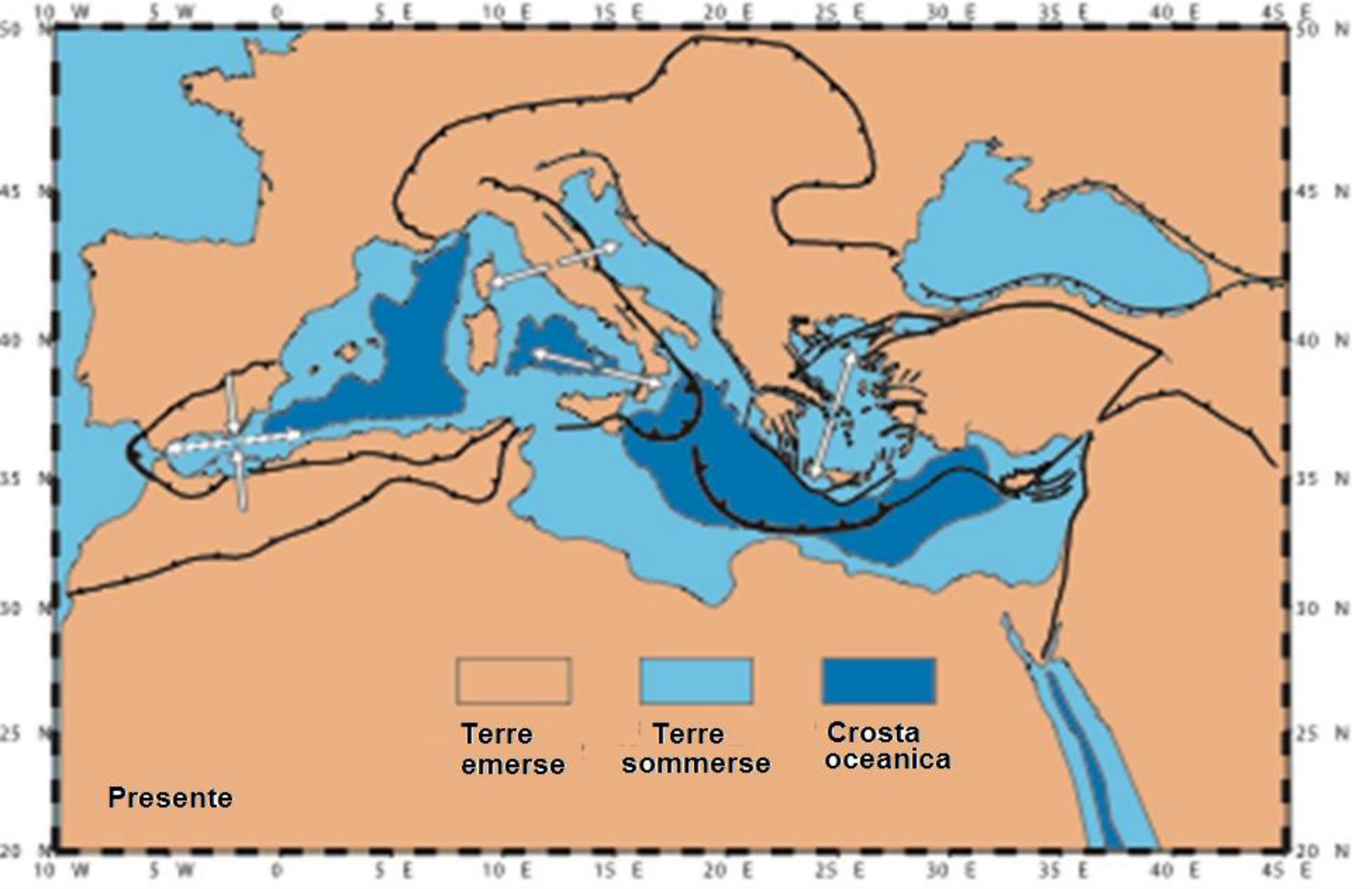












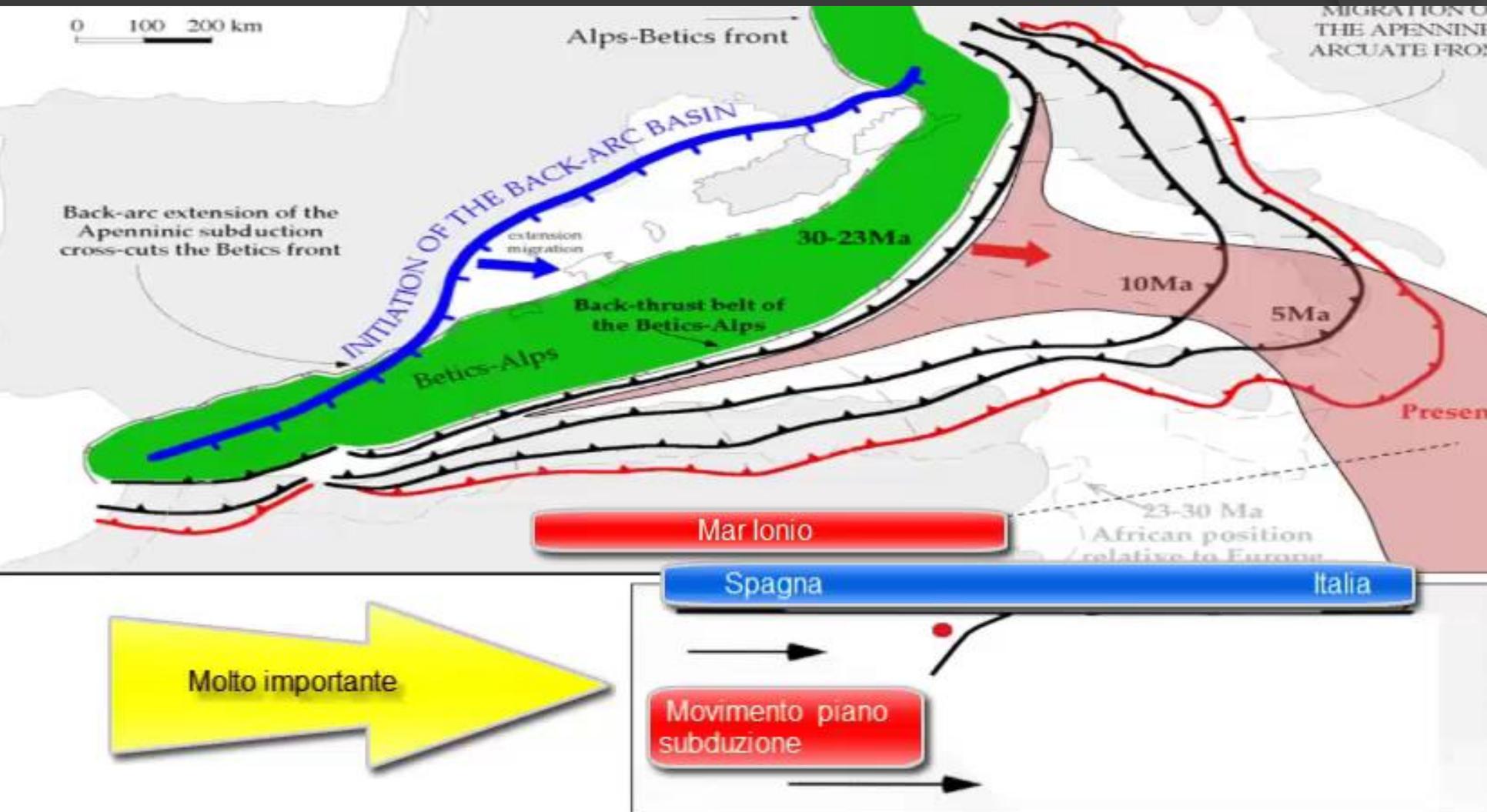
Riassunto ultimi 20 mil. di anni



Oggi

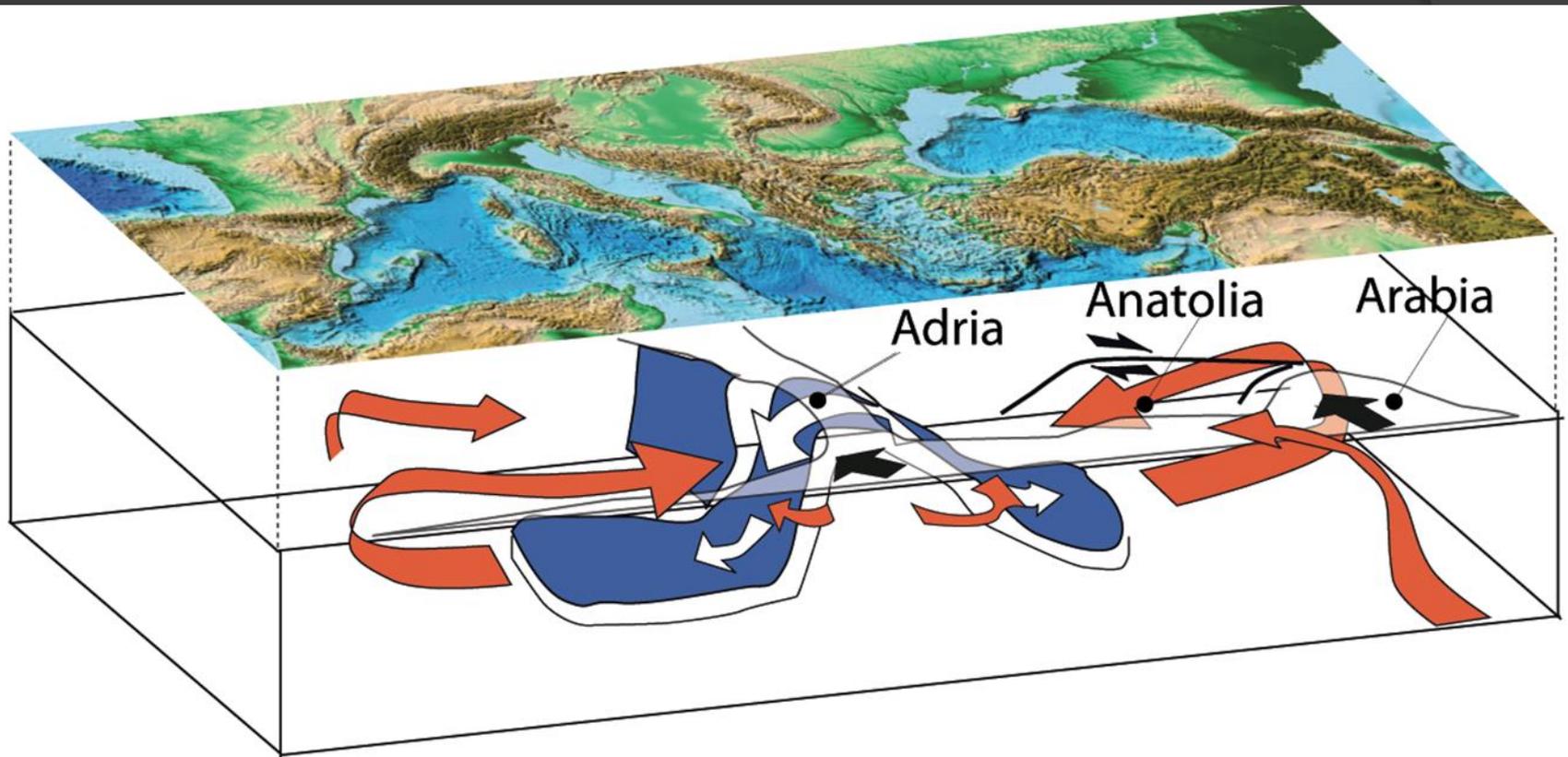


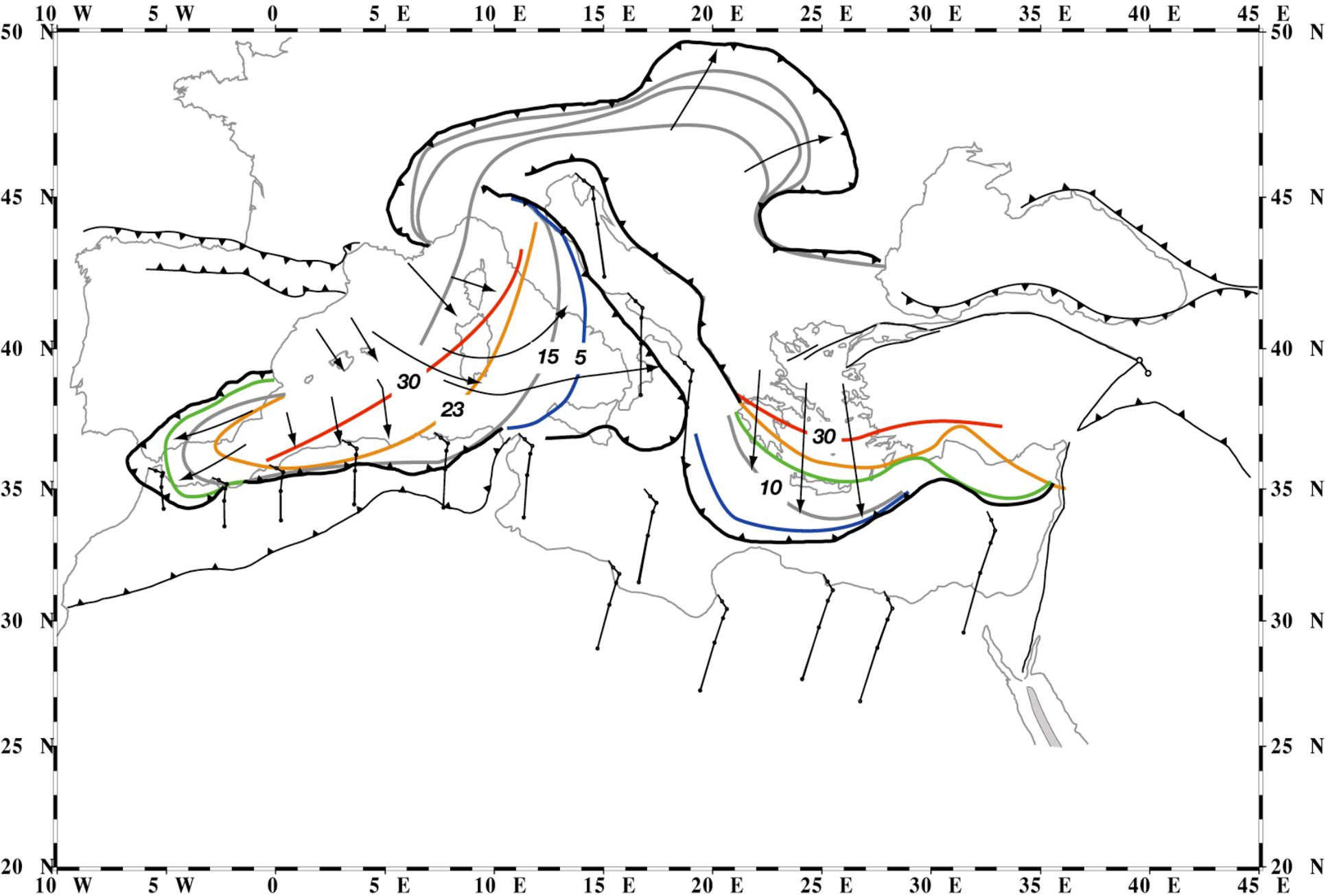
Quel che è successo agli Appennini da 30 milioni di anni a questa parte

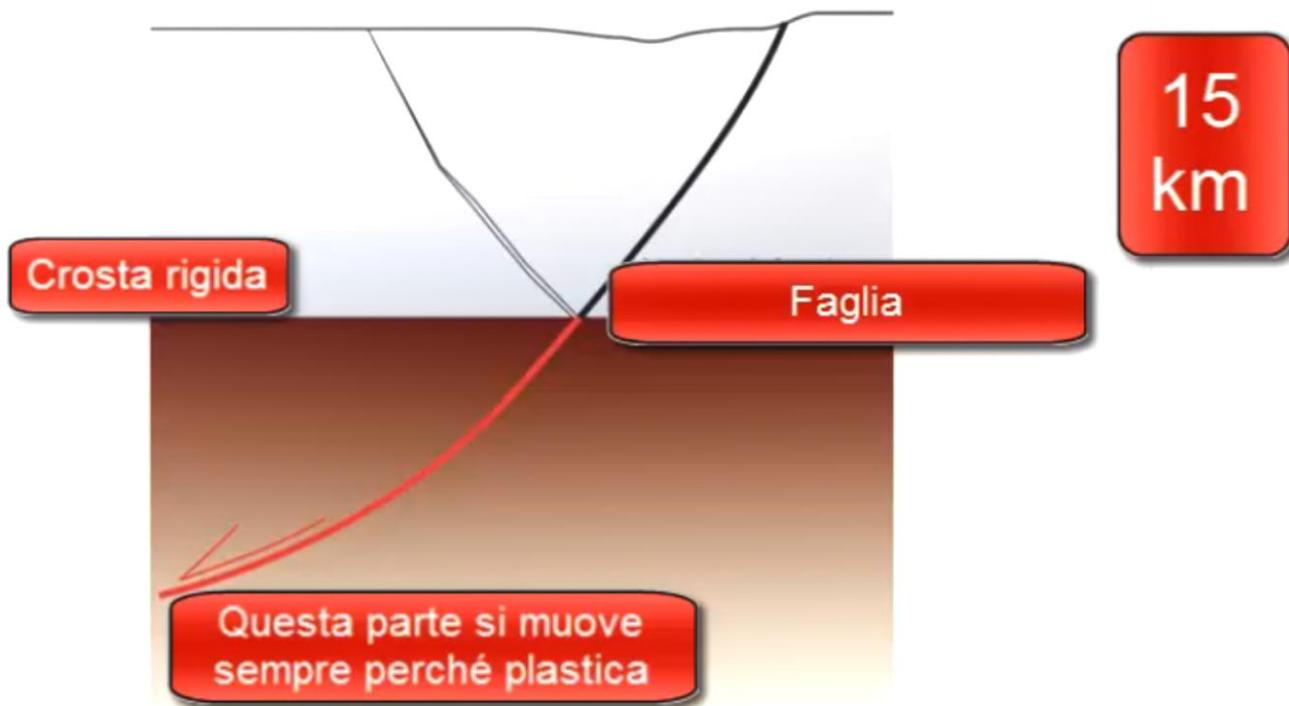


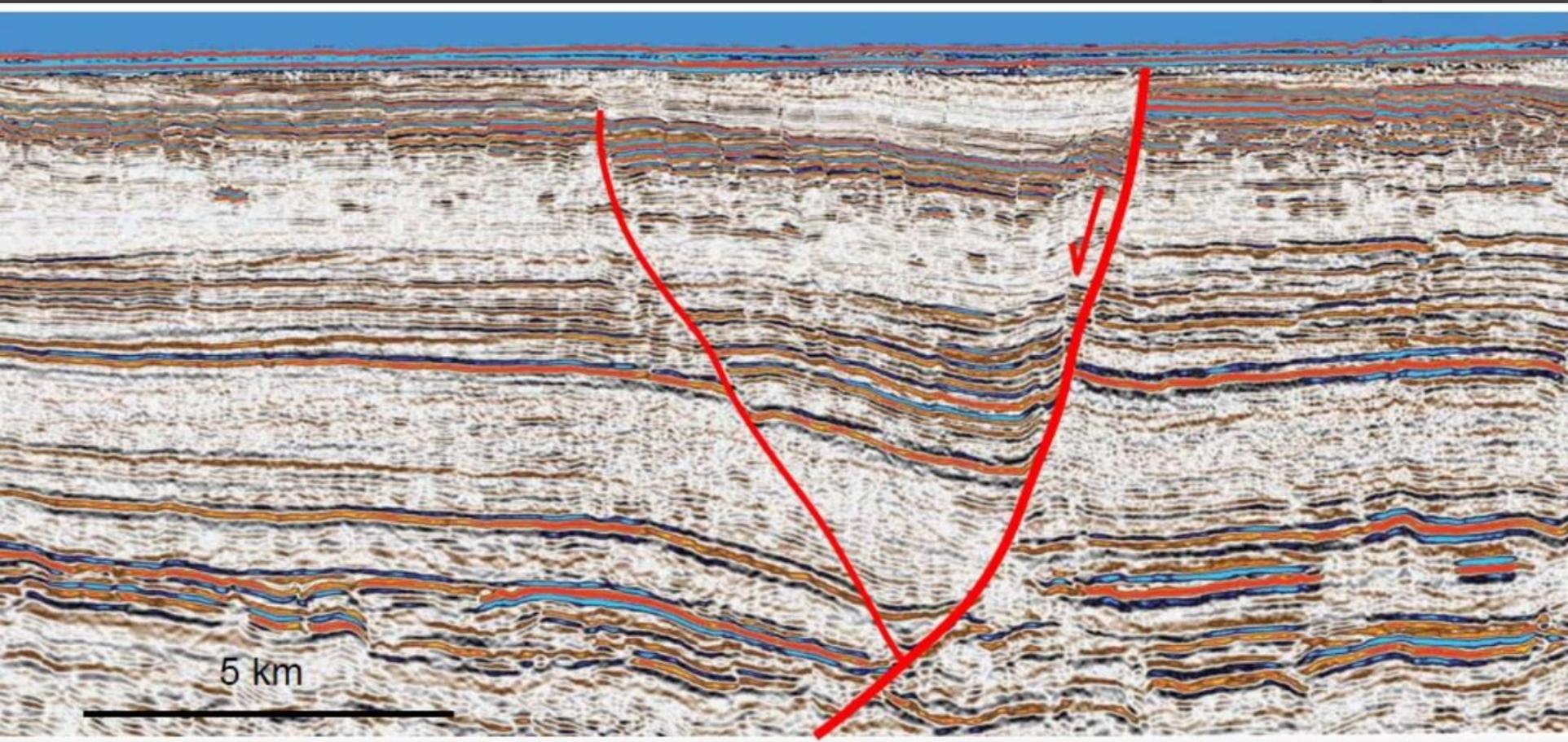


Piani di subduzione attuali





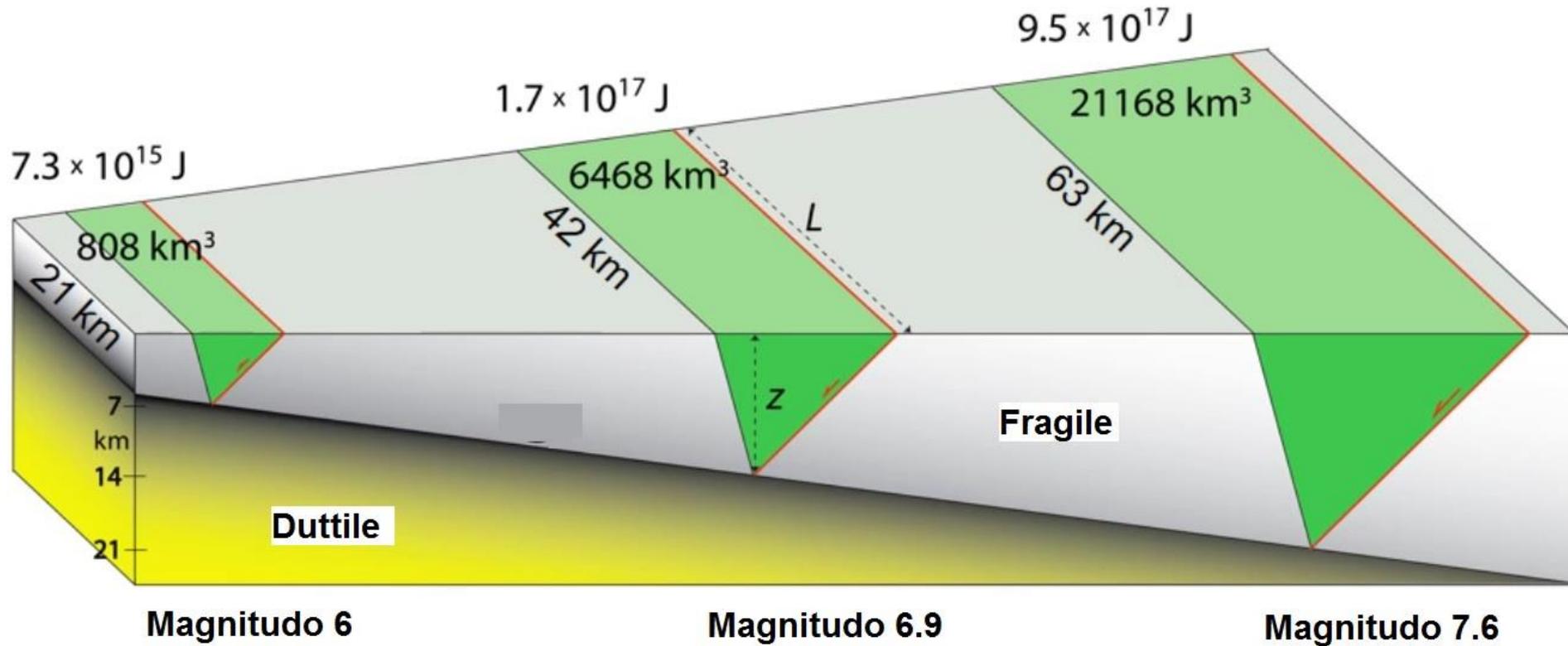




Se si aumenta tre volte il volume:

aumenta 26 volte la massa

aumenta 1000 volte l'energia sismica



Comportamento edificio

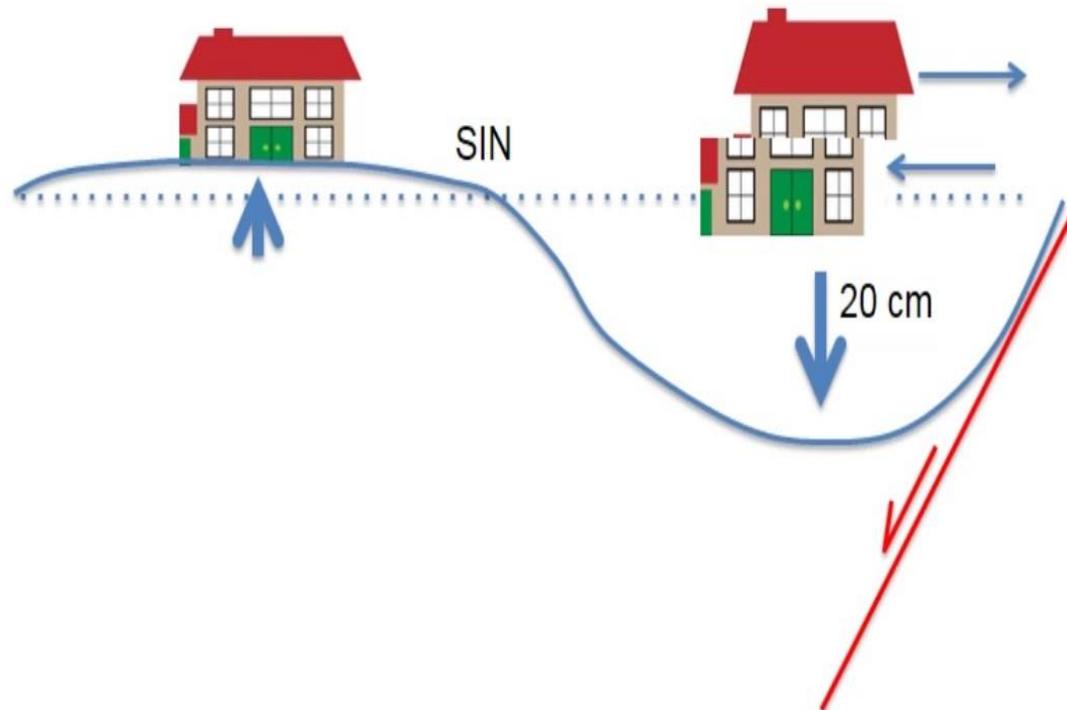


Compressione:

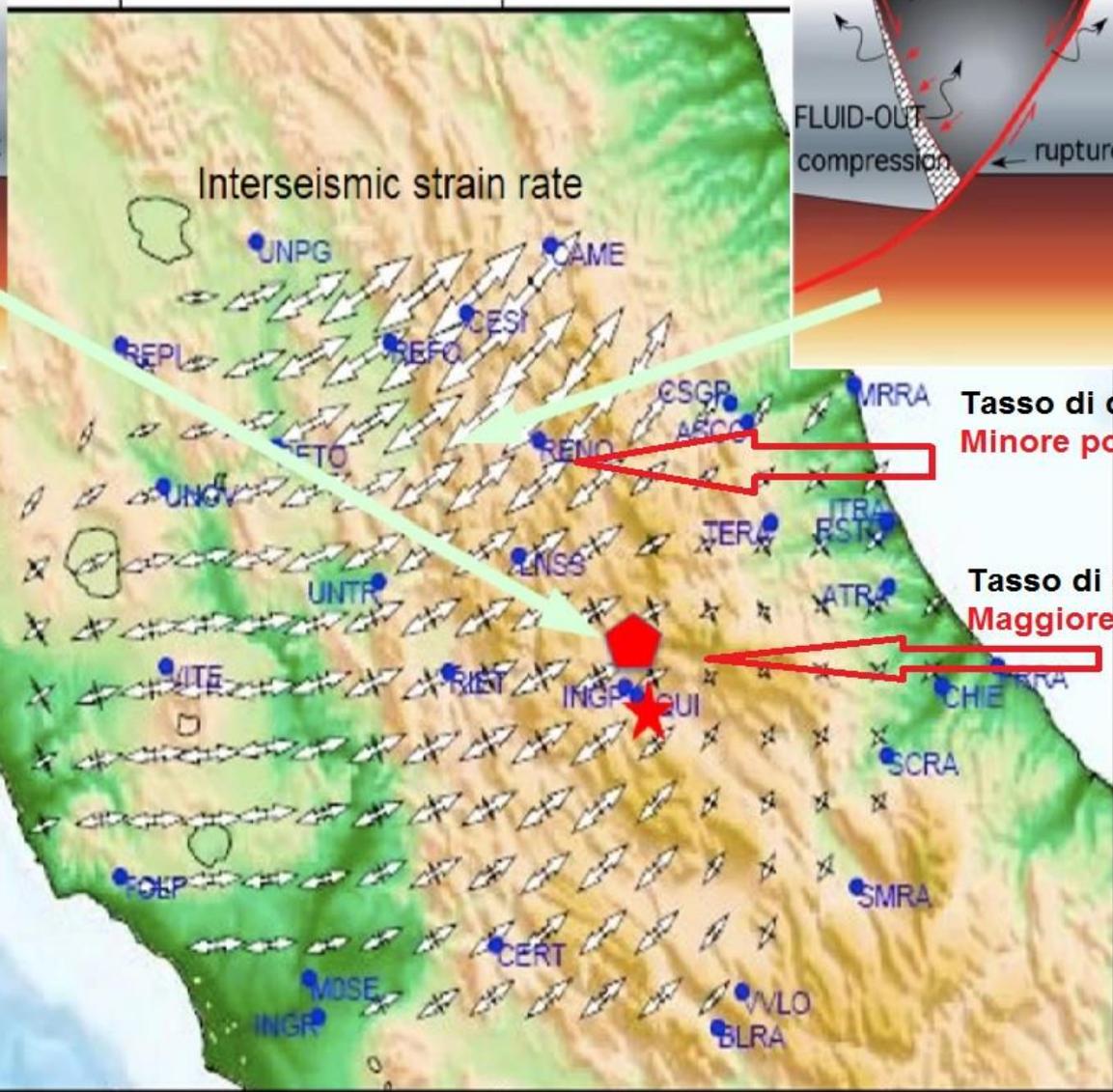
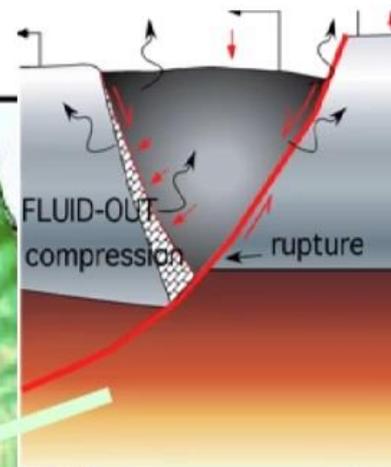
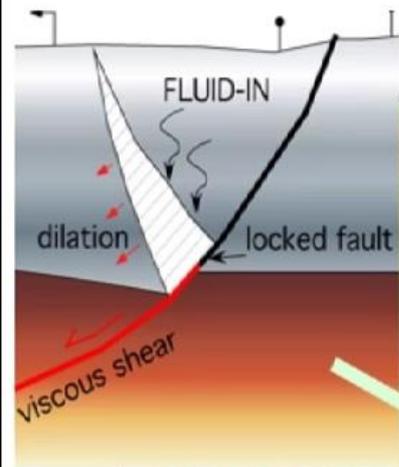
la casa resiste meglio

Dilatazione:

la casa "perde peso" e
resiste meno



Tasso di deformazione e terremoti

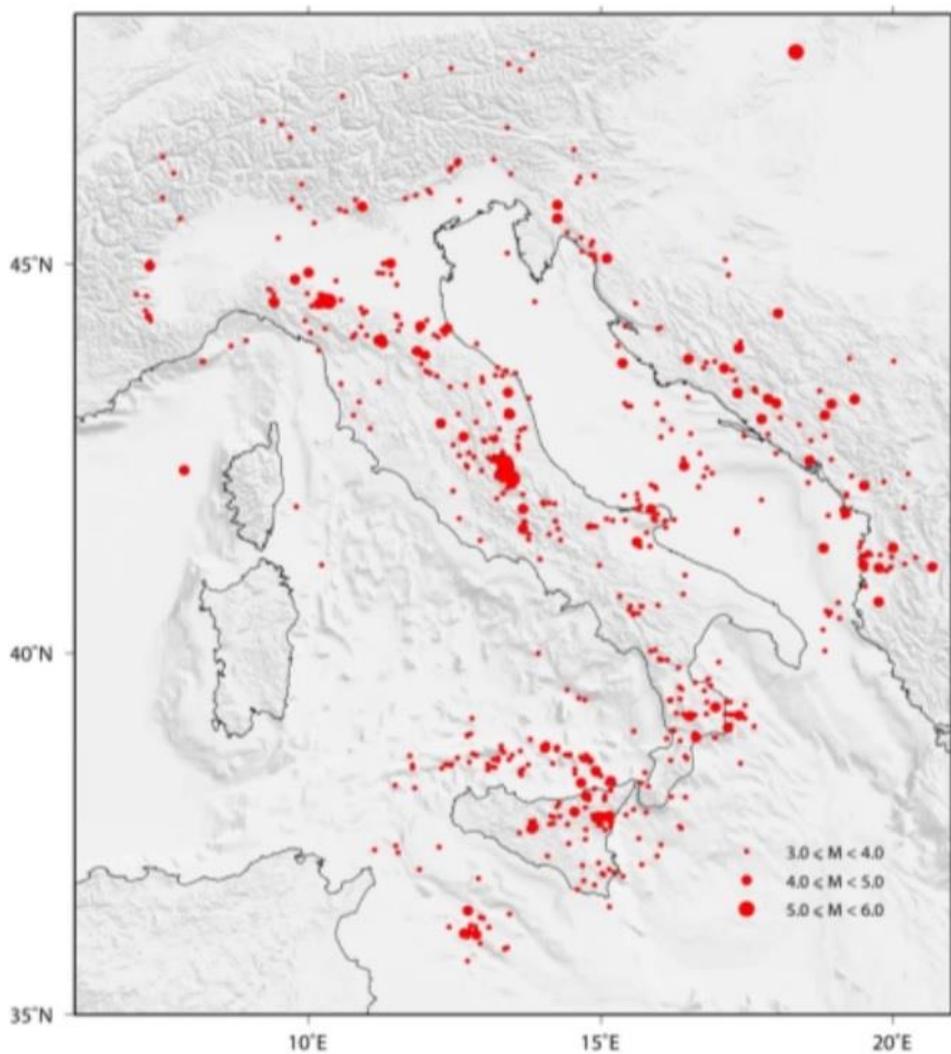


Tasso di deformazione elevato
Minore possibilità di sismi

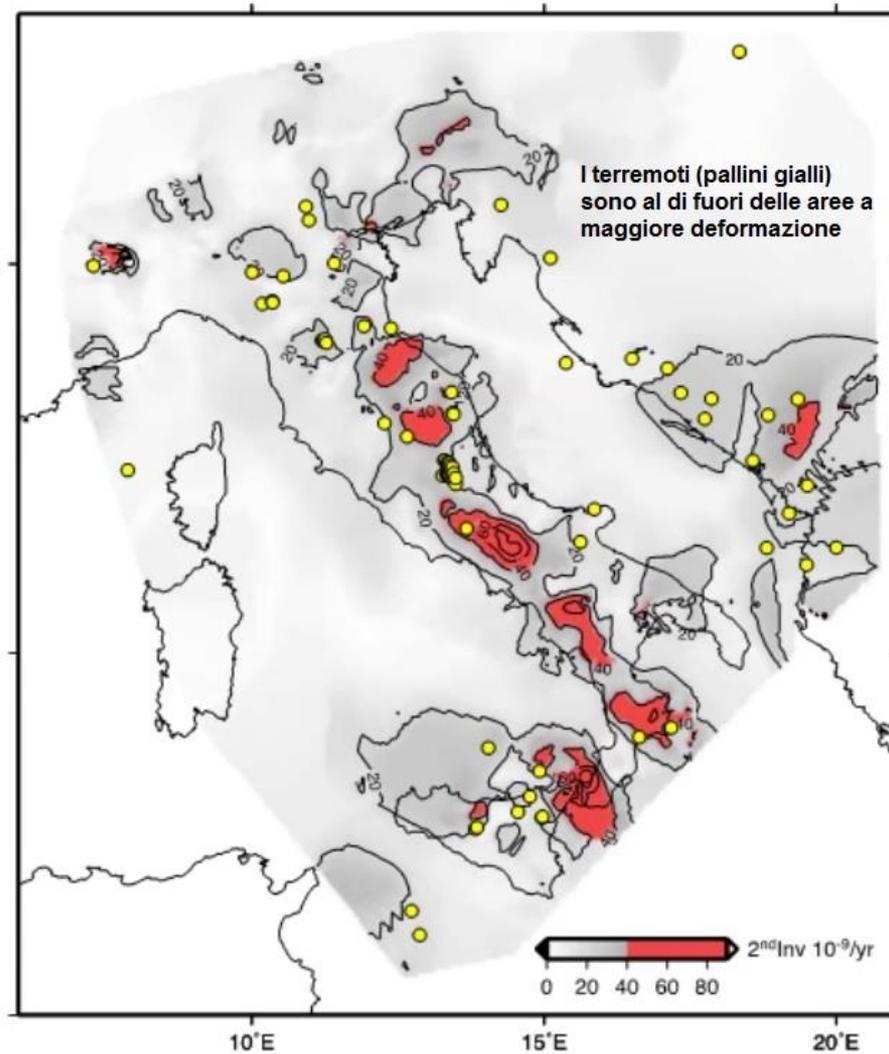
Tasso di deformaione basso
Maggiore possibilità di sismi

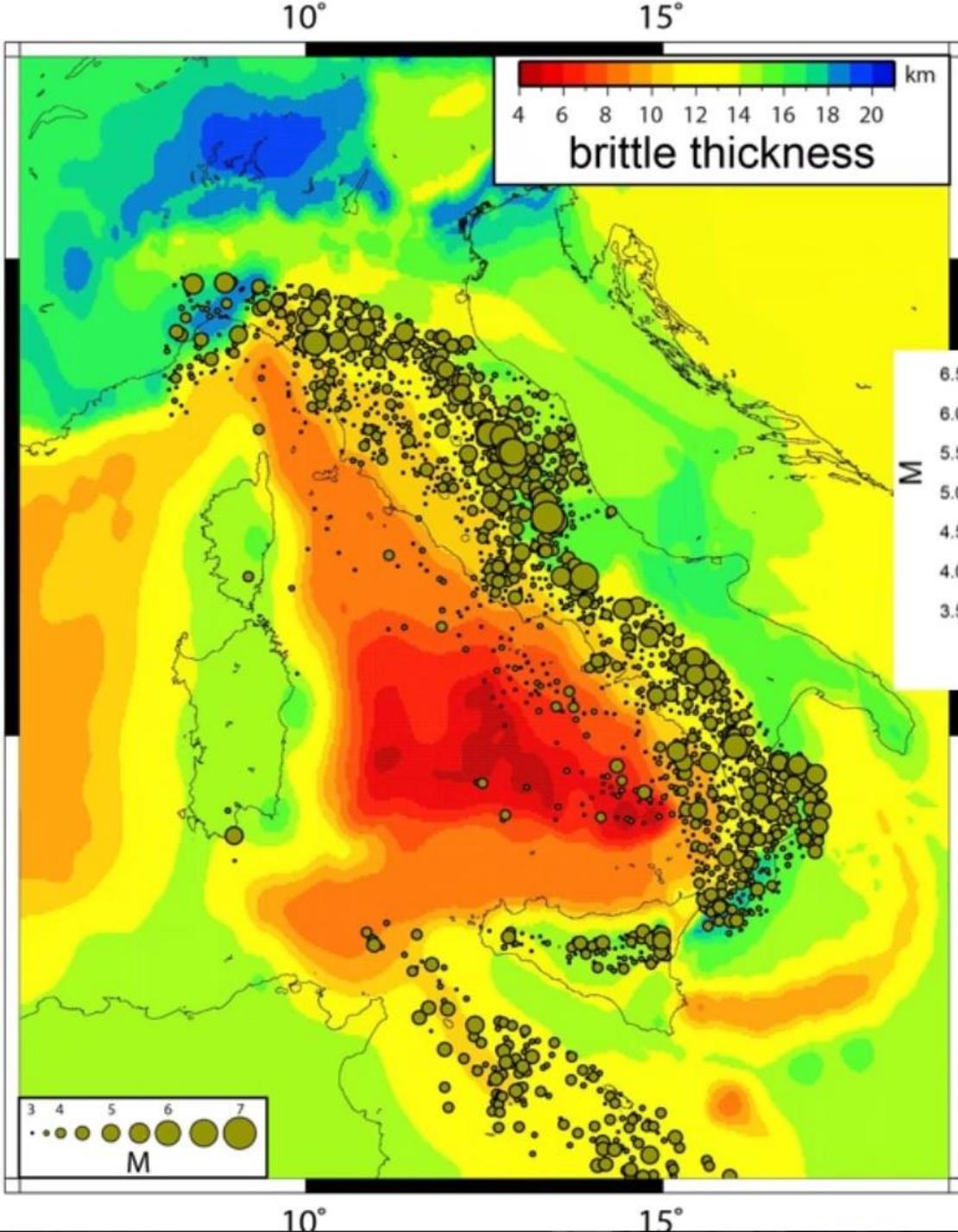
Perché?
Perché si accumula energia

Terremoti 2007 - 2011



Aree rosse a maggiore deformazione

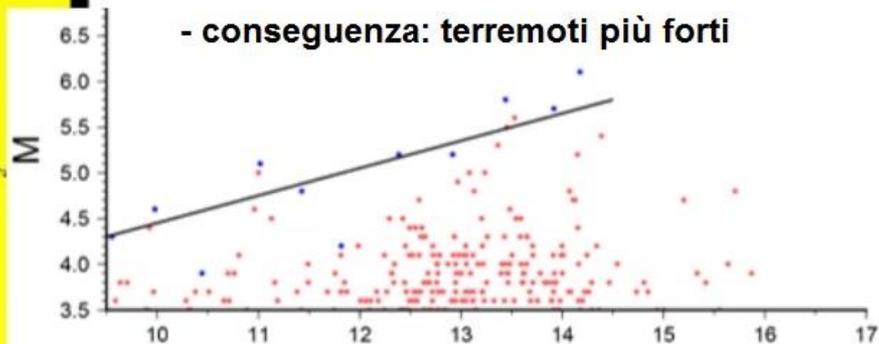




Carta dello spessore della crosta rigida

45° - più si va verso l'Appennino e più spessa è la crosta

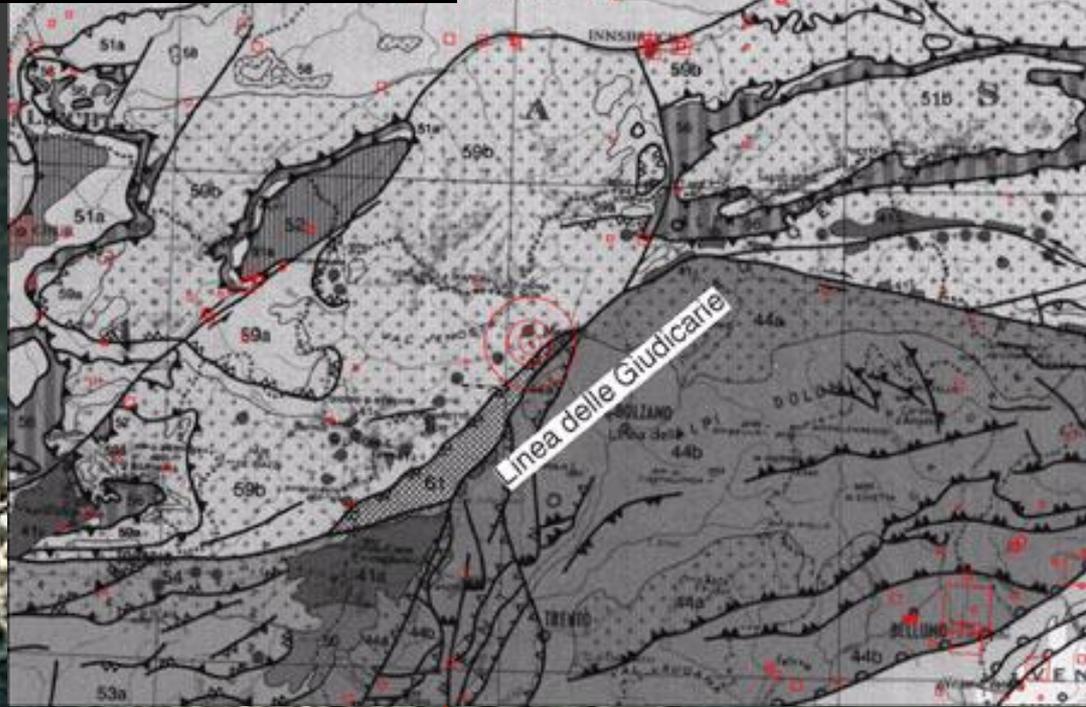
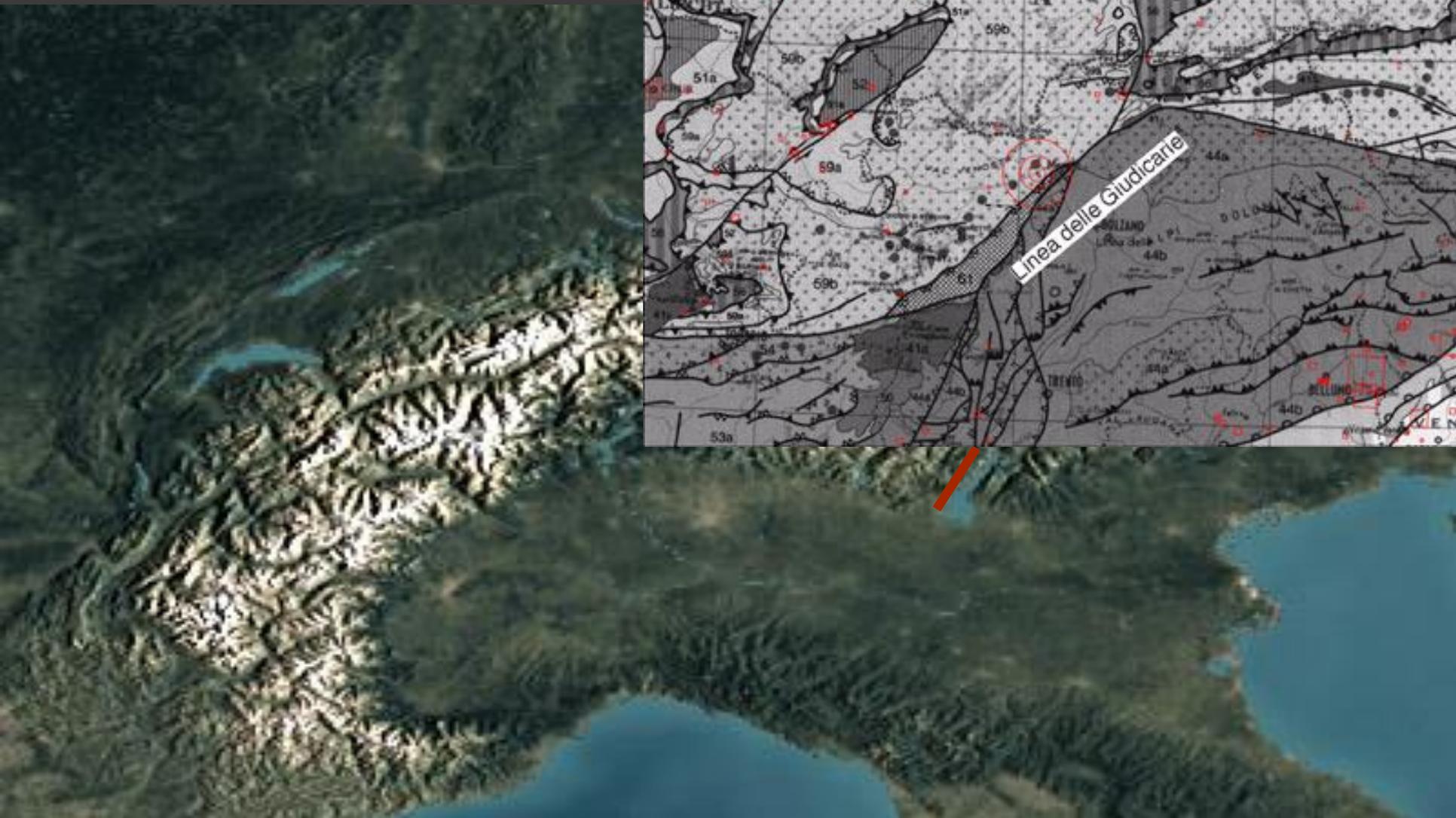
- conseguenza: terremoti più forti



Spessore della crosta rigida

40°

E in Lombardia?



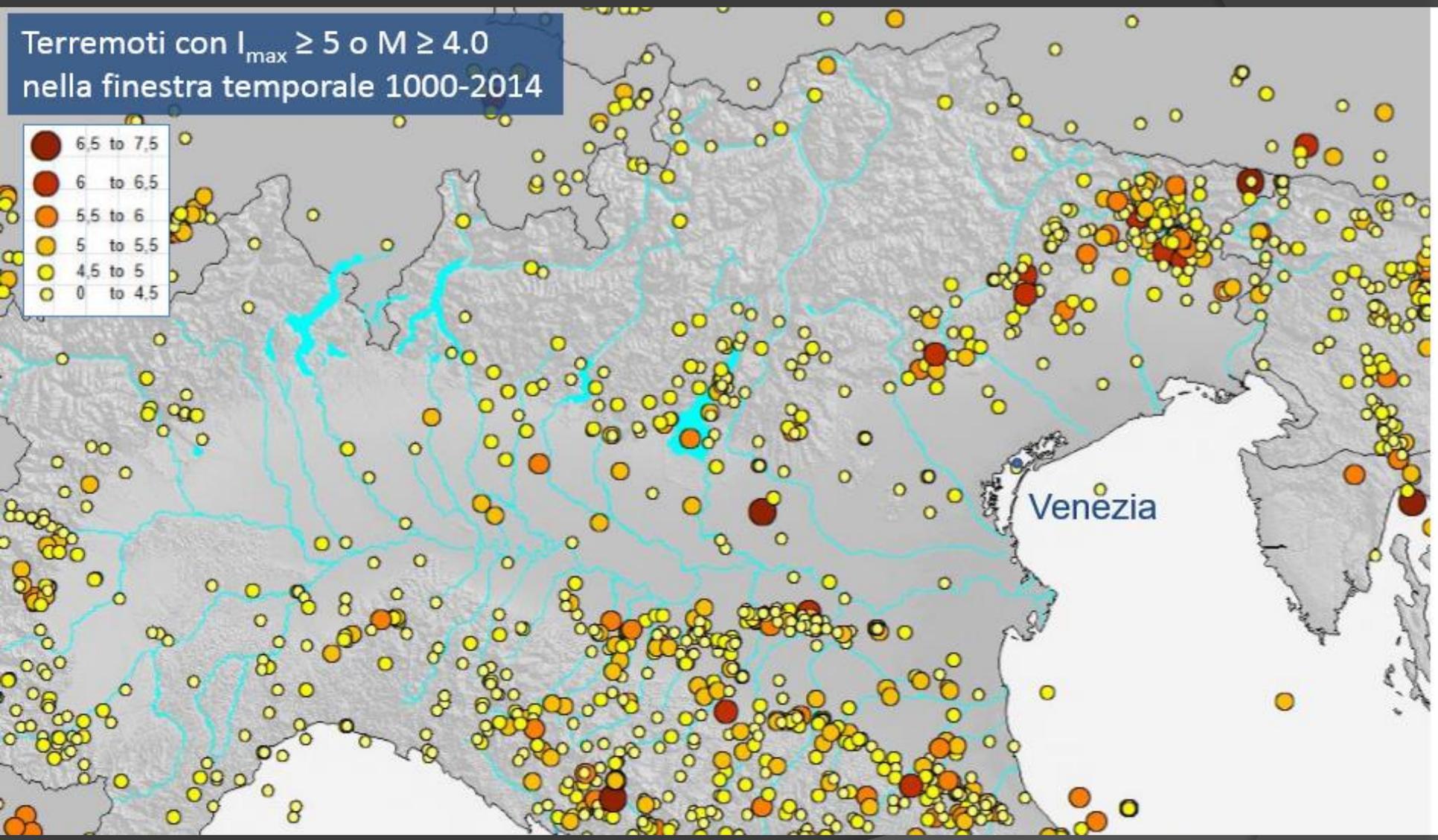
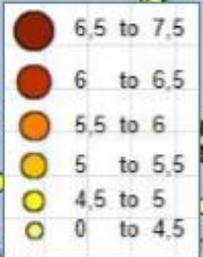


NELLA PIANURA PADANA I TERREMOTI NON SONO PERICOLOSI

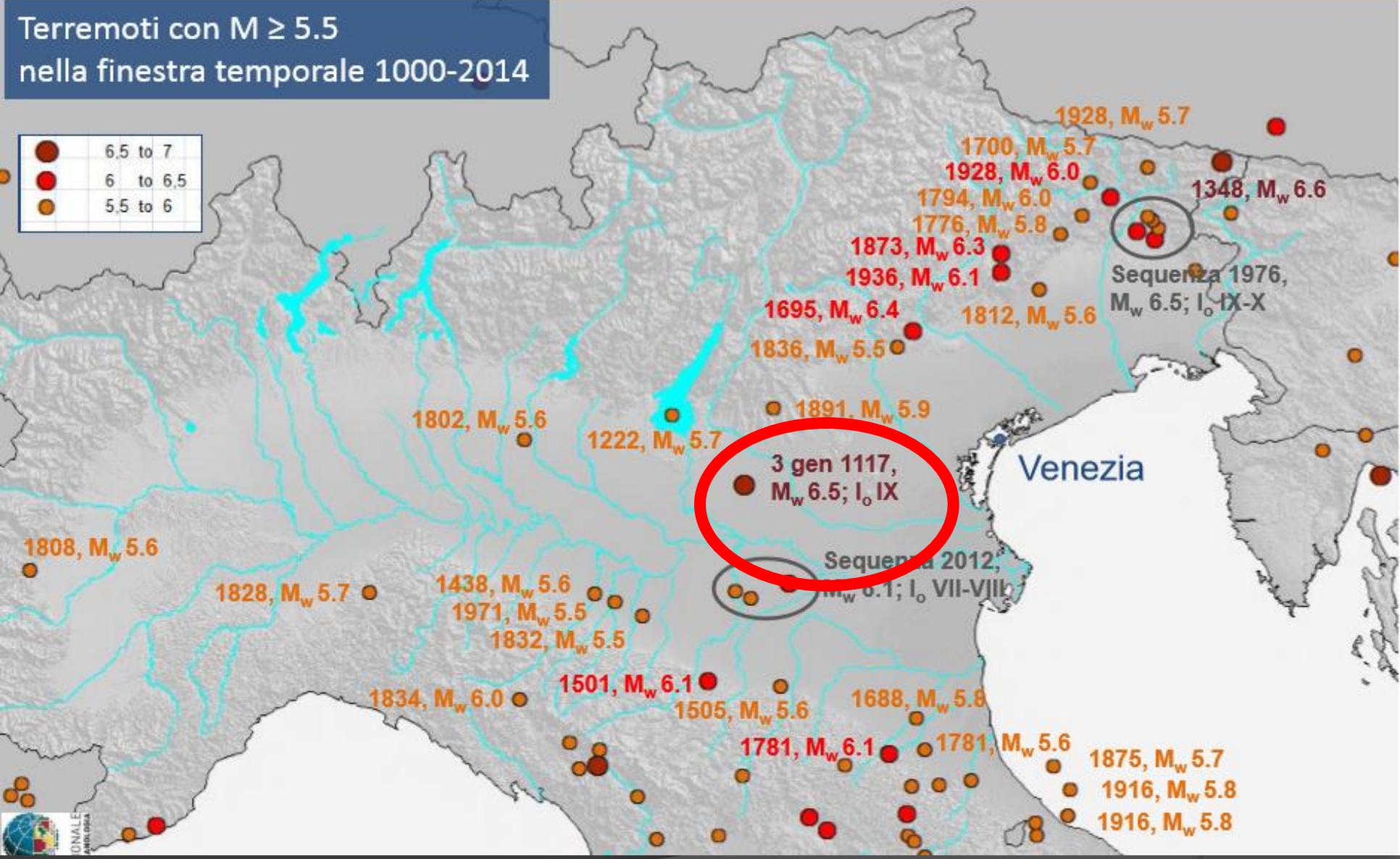
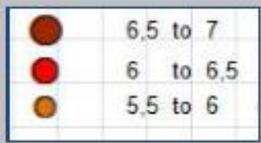
La recente, violenta scossa sismica in Alta Italia, non deve far dimenticare che le probabilità di un moto tellurico disastroso sono estremamente rare nella Valle del Po

Settimanale "Oggi" del 24 maggio 1951

Terremoti con $I_{max} \geq 5$ o $M \geq 4.0$
nella finestra temporale 1000-2014

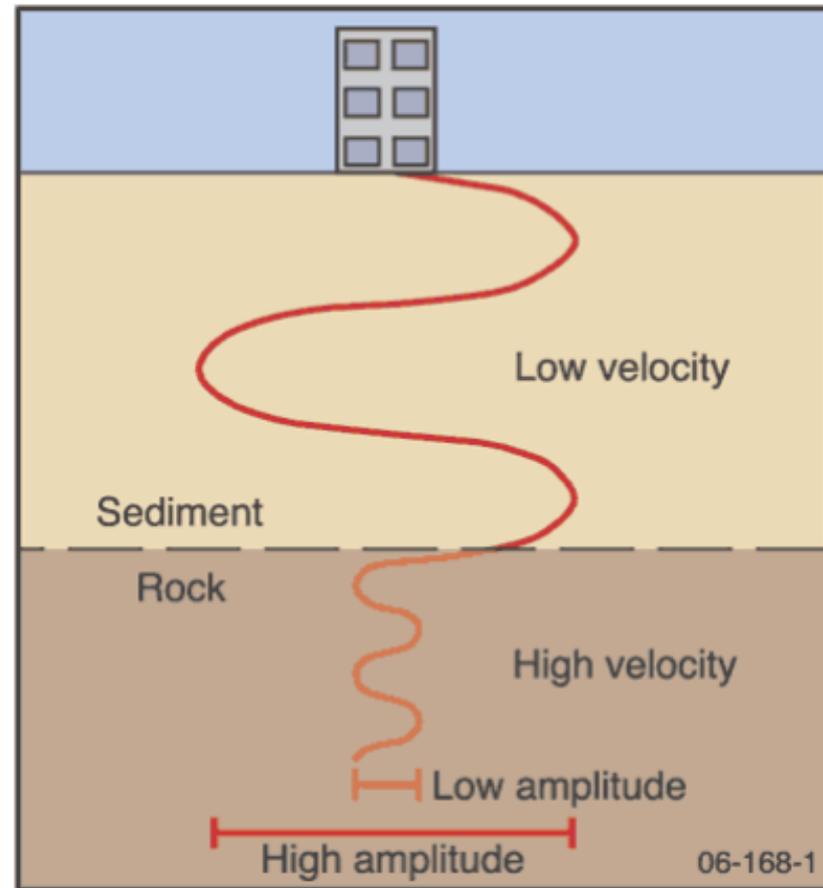


**Terremoti con $M \geq 5.5$
nella finestra temporale 1000-2014**



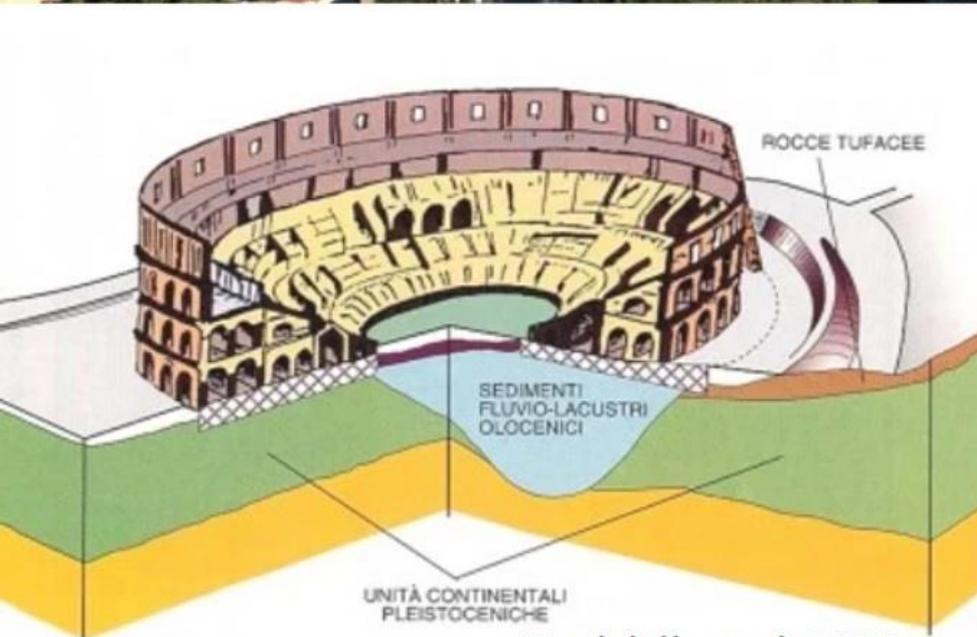
Nelle rocce cristalline la velocità è elevata e l'ampiezza delle onde piccola

Nelle rocce sedimentarie la velocità diminuisce e le onde si ingigantiscono



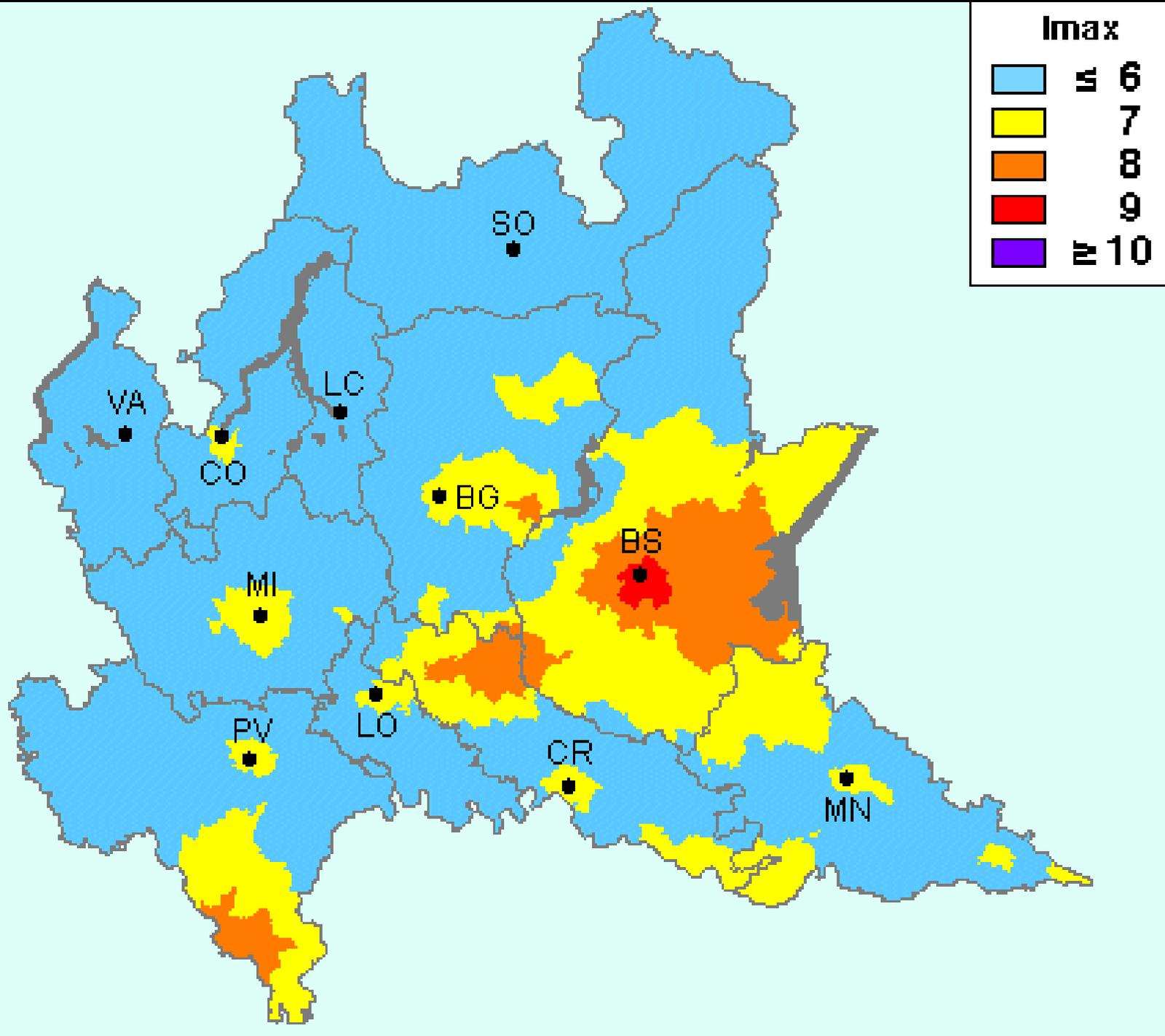
443, 484-508, ecc. A.D.

Colosseo e terremoti in Appennino !!!!



Funiciello et al. 2006



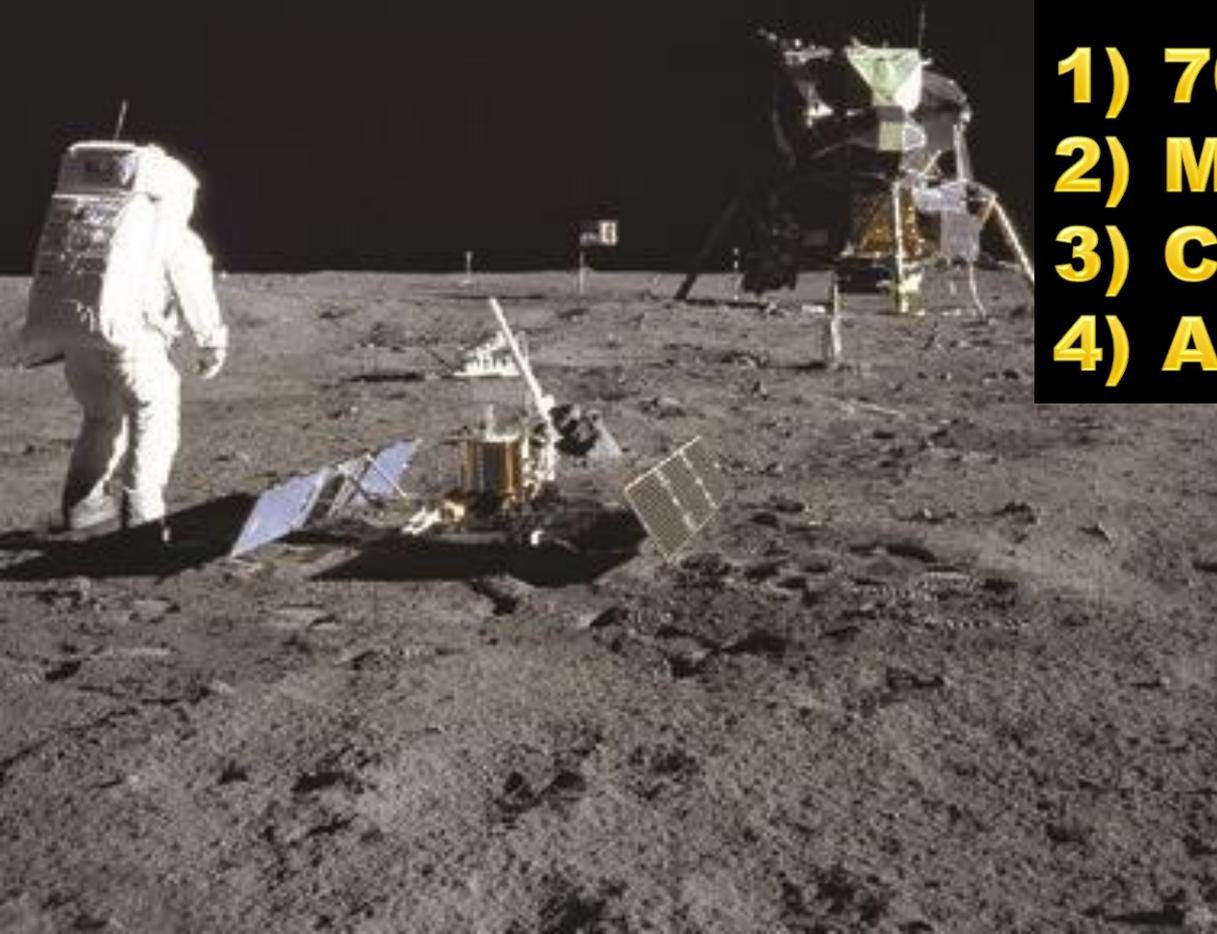


E sulla Luna?

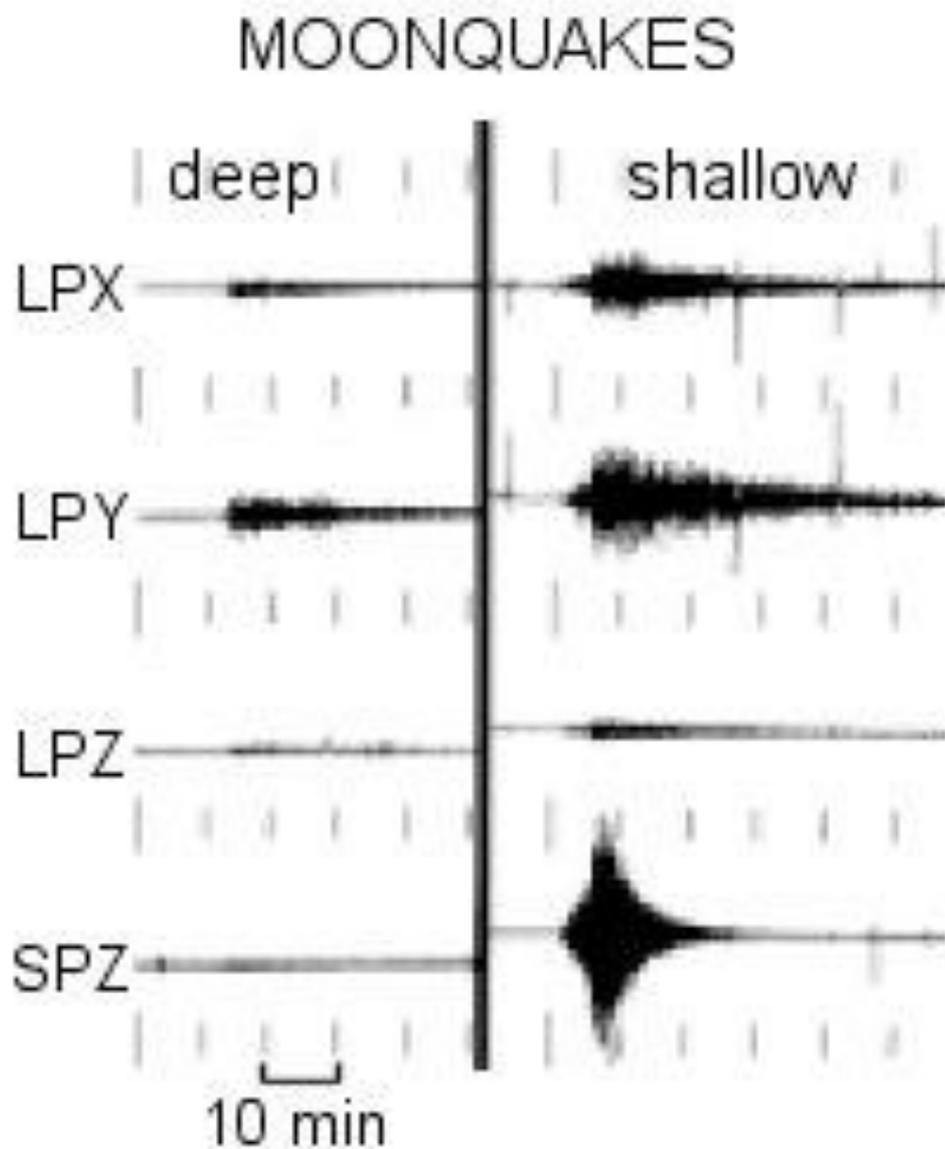
Apollo 12,14, 15 e 16

4 tipi:

- 1) 700 km (maree?)**
- 2) Meteoriti**
- 3) Caldo e freddo**
- 4) A 20 - 30 km (???)**



Risuona tantissimo...



**Anche
5,5° M**

E su Marte?

← Boulder trail

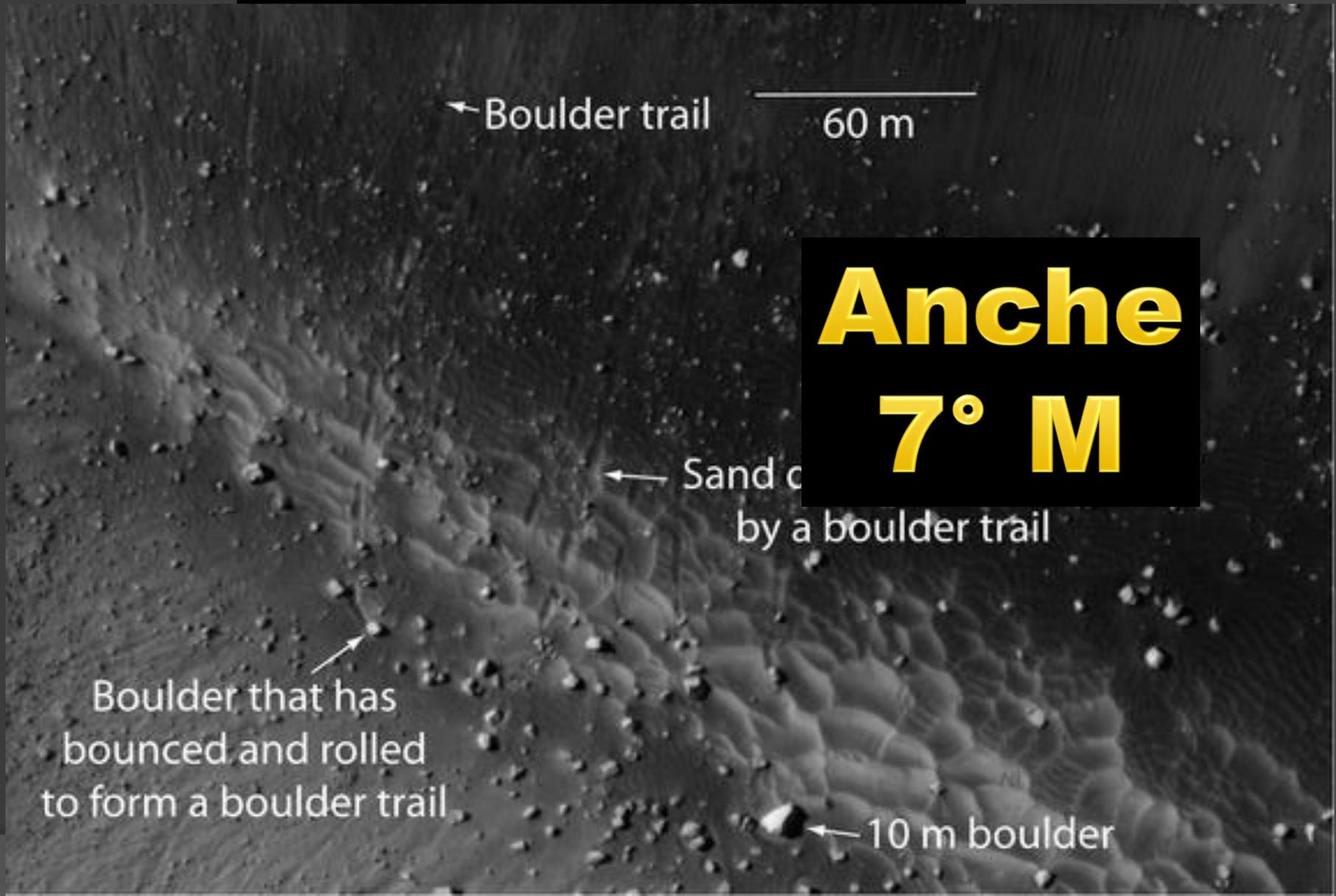
60 m

**Anche
7° M**

← Sand covered
by a boulder trail

←
Boulder that has
bounced and rolled
to form a boulder trail

← 10 m boulder



**Nella speranza di
non avervi annoiato...**

Fine

