Associazioni di strutture tettoniche

Dalla scala dell'affioramento alla scala regionale

Immagini e fotografie tratte da:

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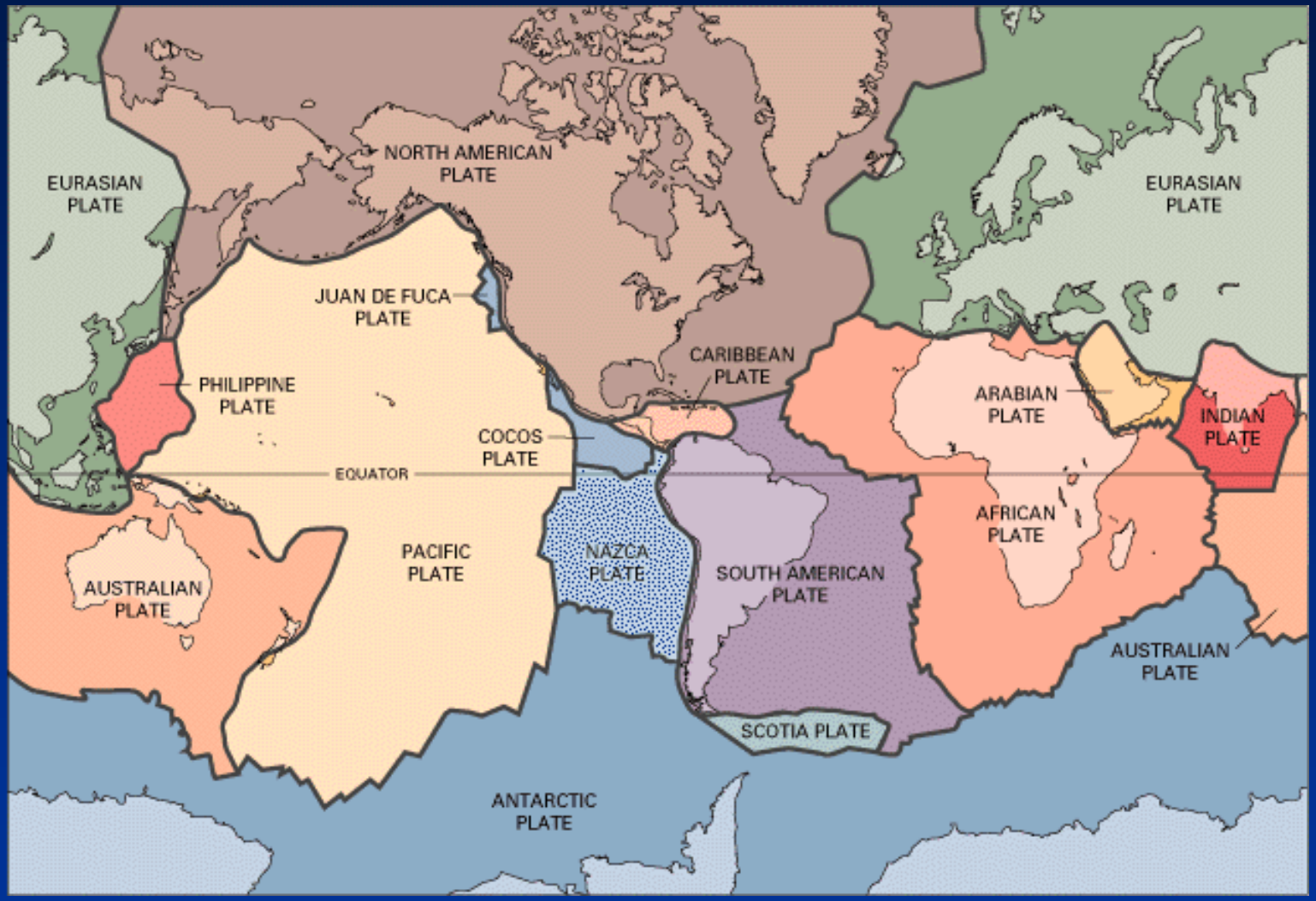
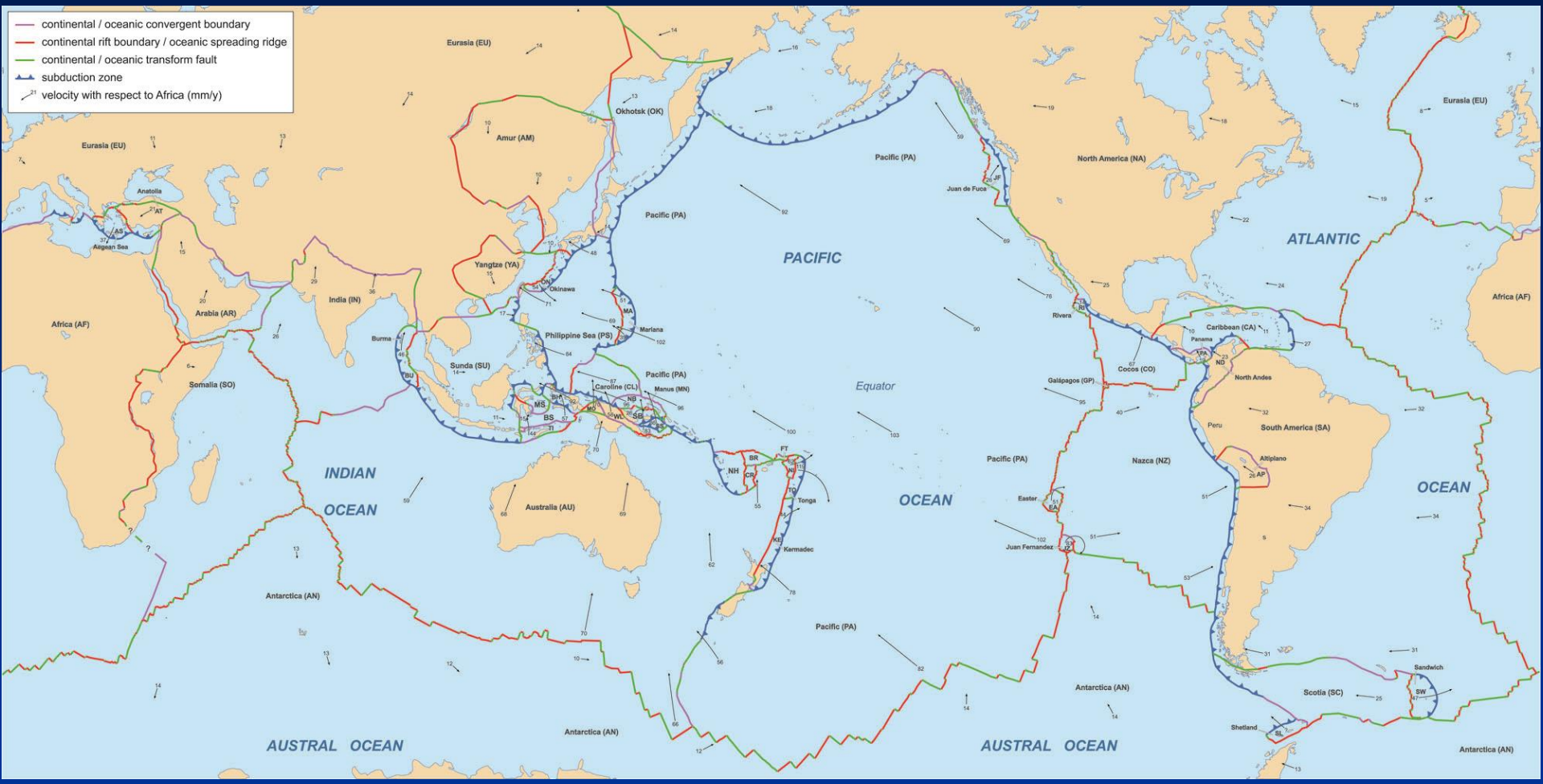
Placche tettoniche (semplificate)



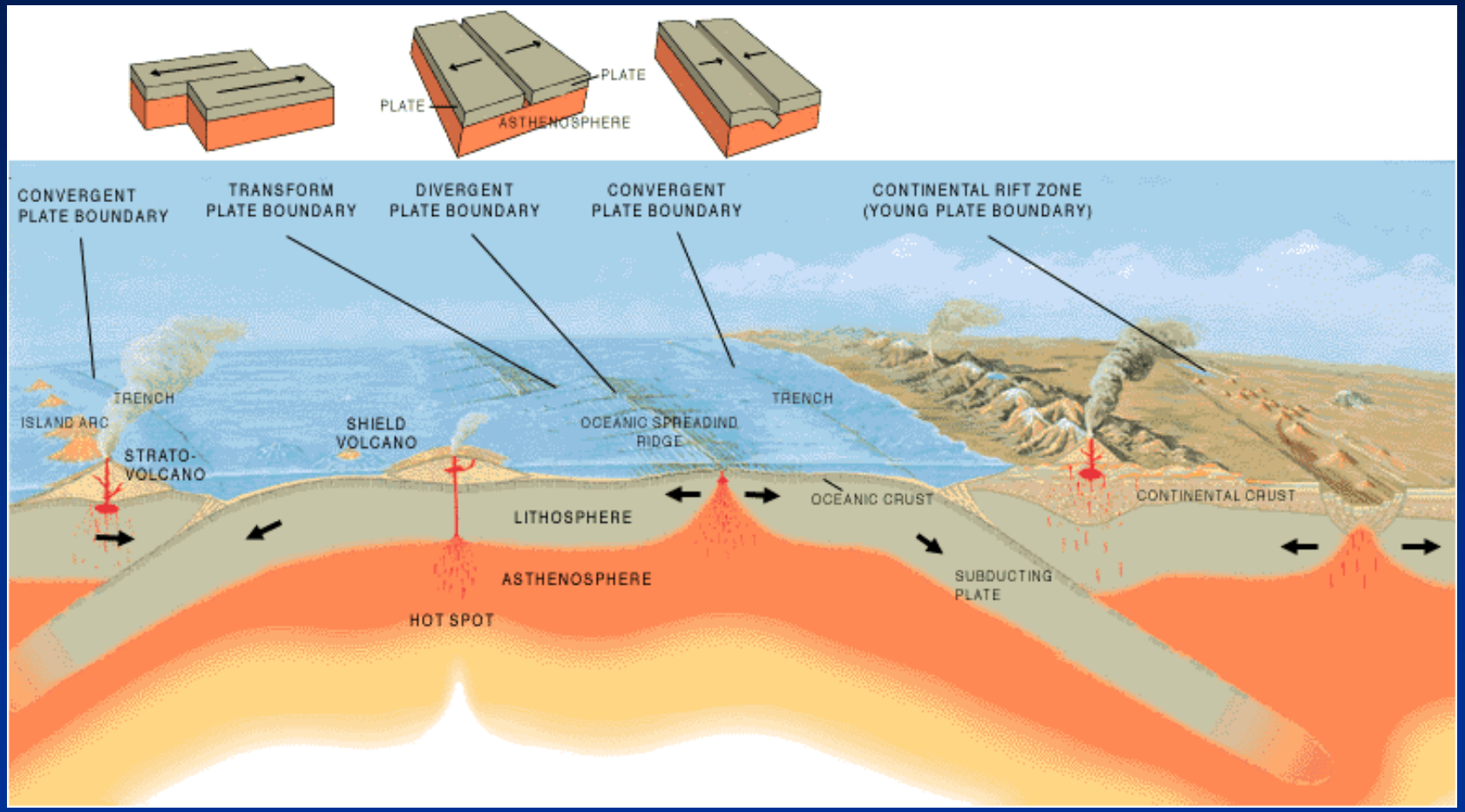
Da "The dinamic Earth" in USGS Web Site

Placche tettoniche e limiti tra placche



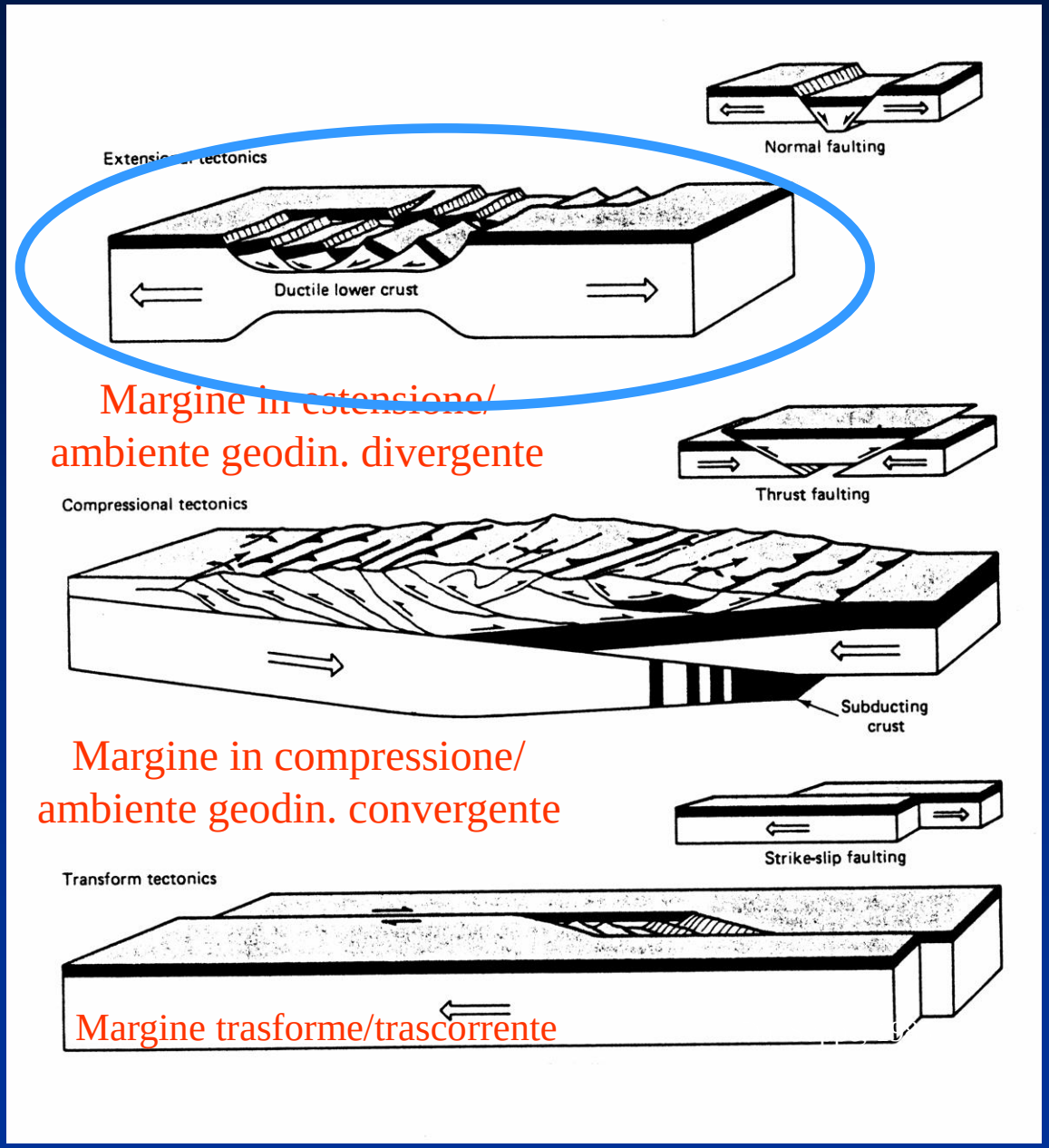
https://commons.wikimedia.org/wiki/File:Tectonic_plates_boundaries_detailed-en.svg

Tipo di margini di placca e ambienti geodinamici



http://factsanddetails.com/world/cat51/sub323/item2212.html

Tipo di margini di placca e ambienti geodinamici



Margine in estensione/
ambiente geodin. divergente

Margine in compressione/
ambiente geodin. convergente

Margine trasforme/trascorrente

Da Suppe, 1985

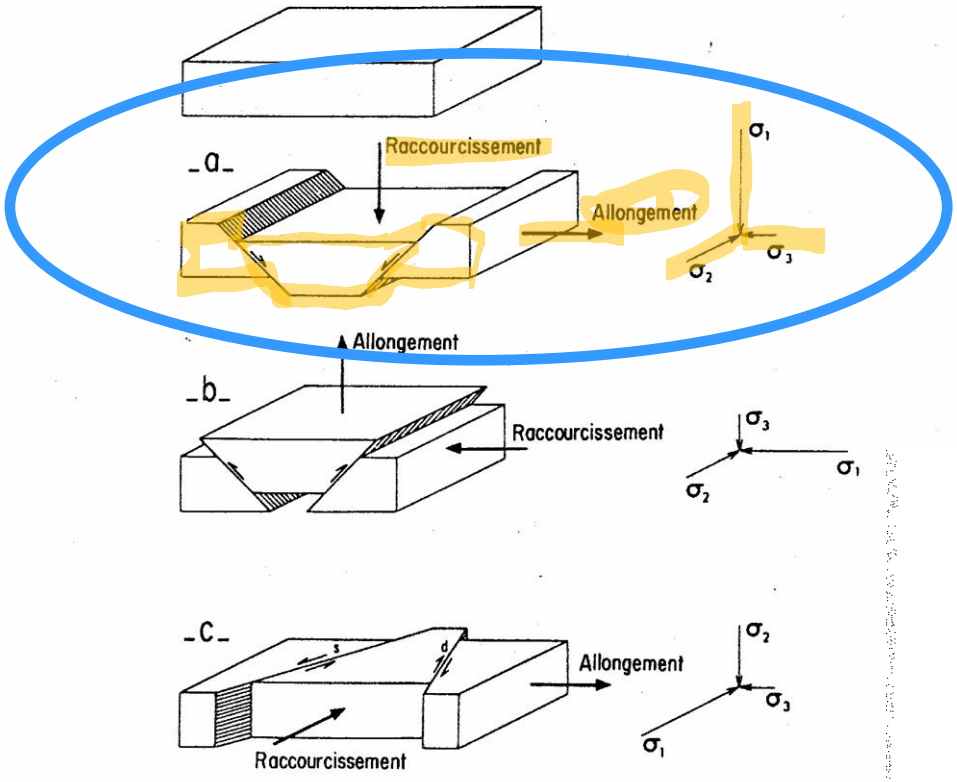
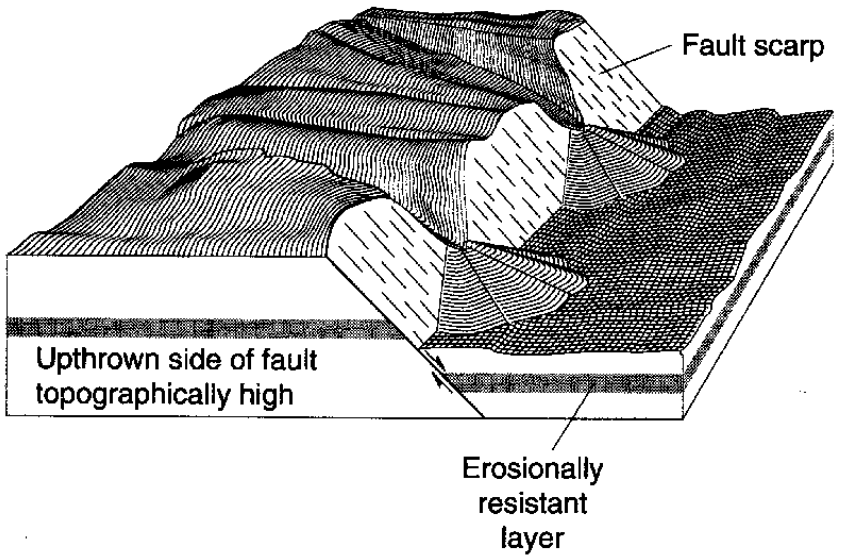


Fig. 5.12 - Systèmes de failles conjuguées. a- Failles normales conjuguées, Failles inverses conjuguées, horst. c- Décrochements dextre et senestre conju çon.(Blès et Feuga, 1981. BRGM éd., Orléans).

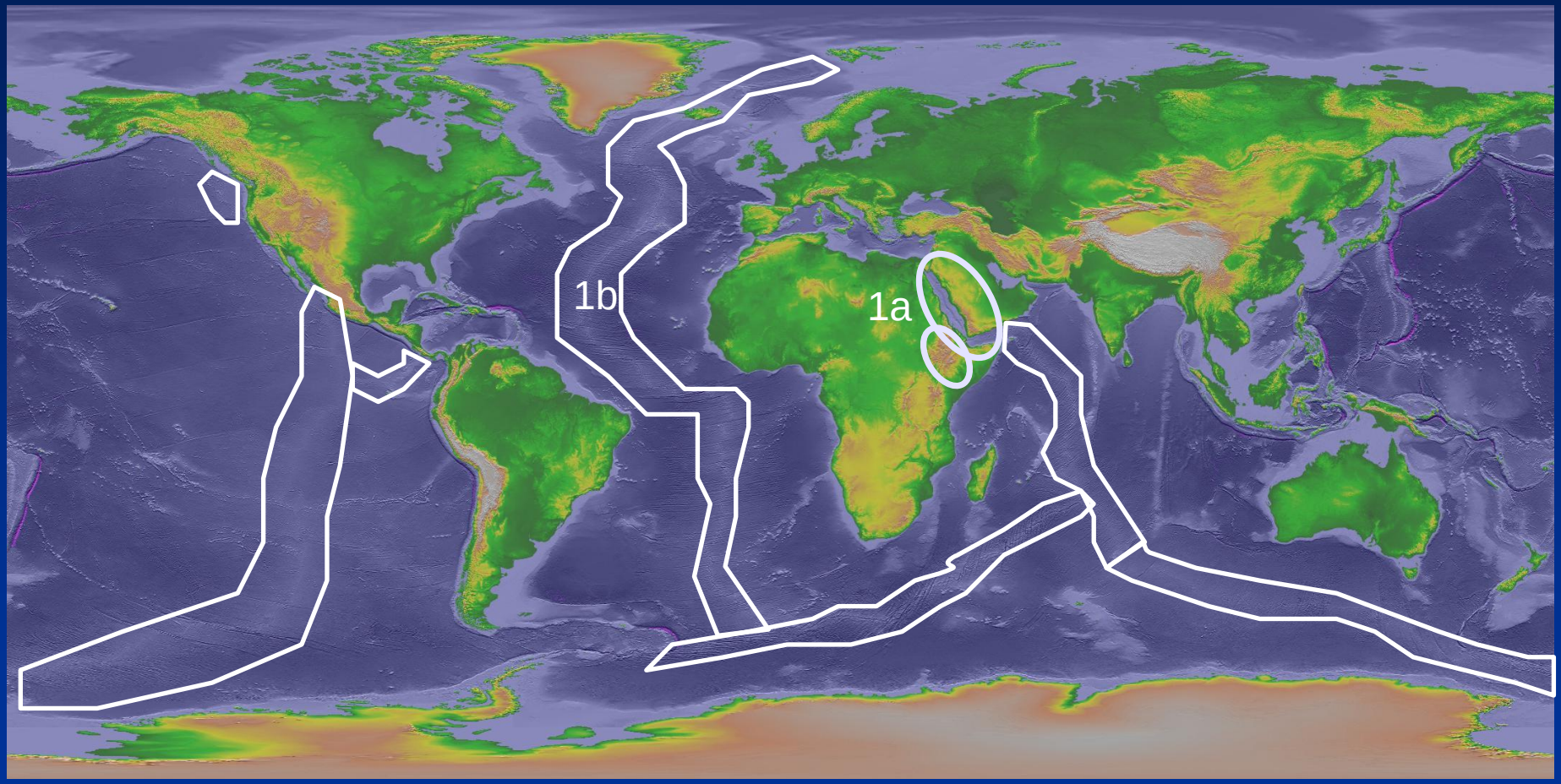
Da Nicolas, 1984

Da Hatcher, 1995

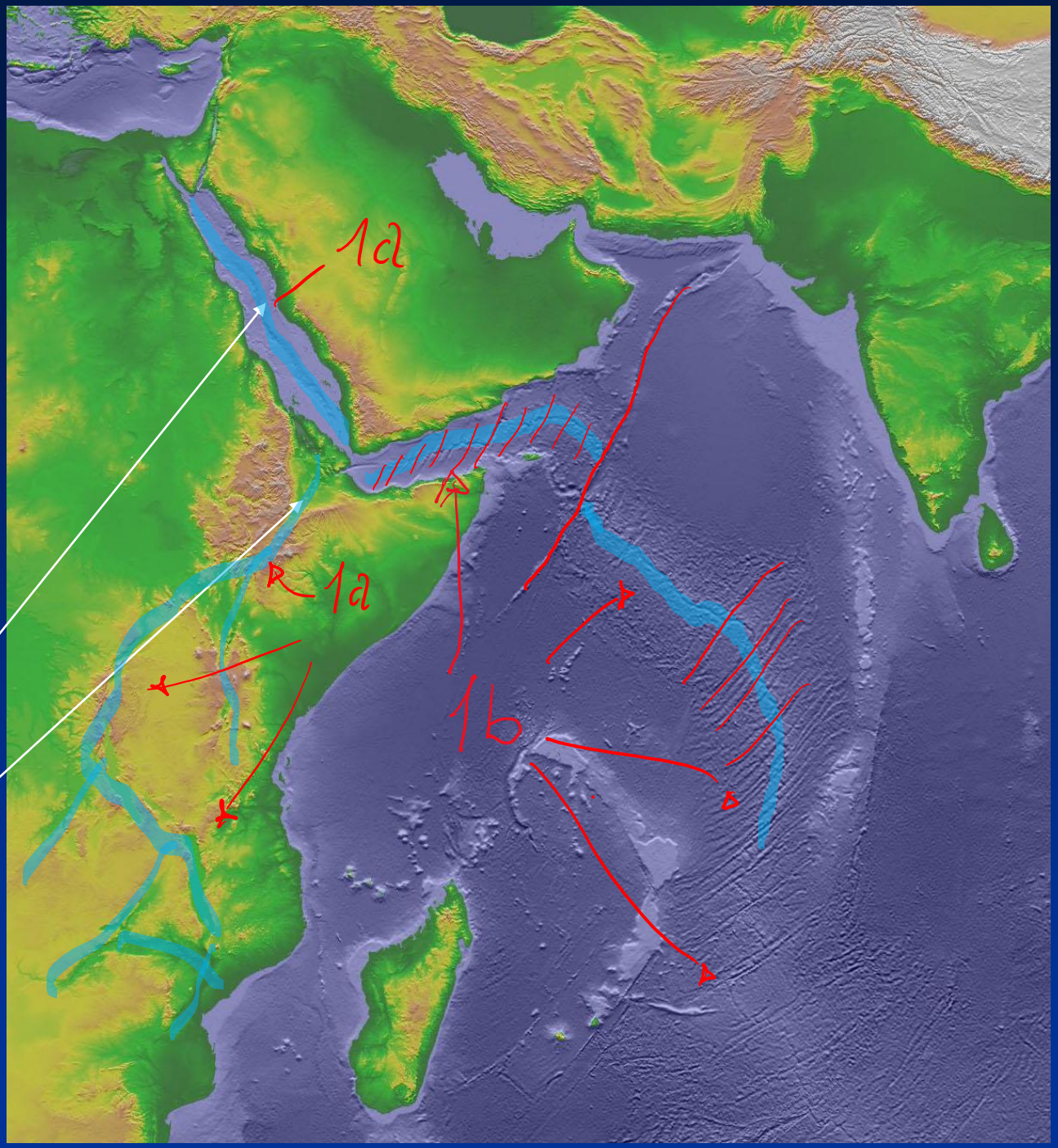


Associazioni di faglie normali

1) associazioni estensionali in ambienti geodinamici divergenti



1a) estensione e assottigliamento di crosta continentale che porta a crosta oceanica (*from rift to drift*)

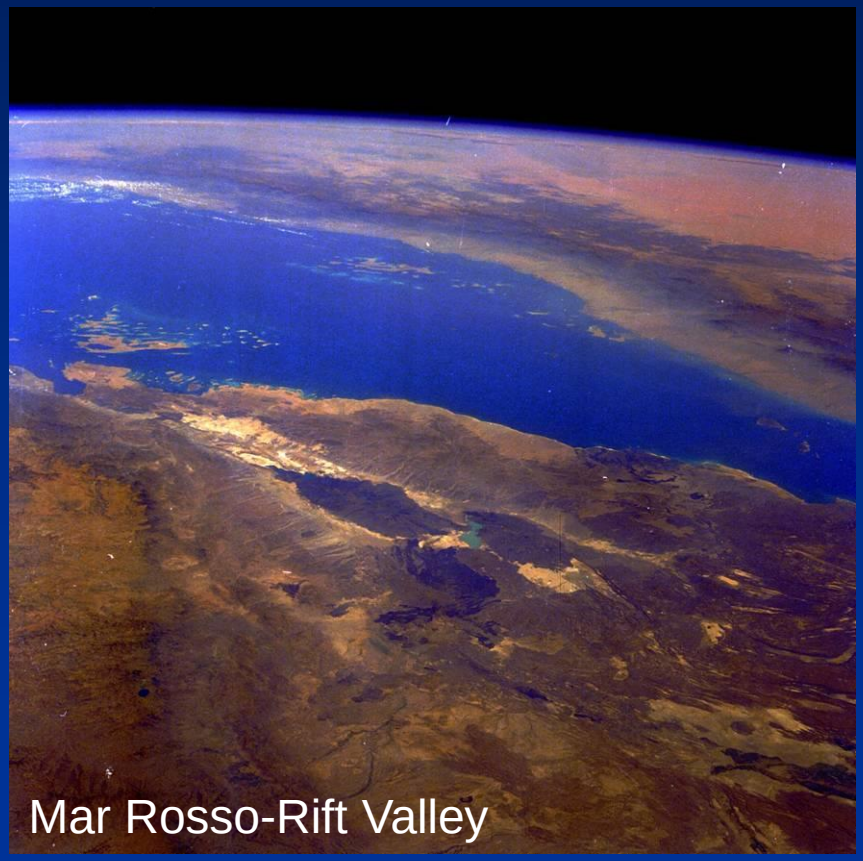


Mar Rosso

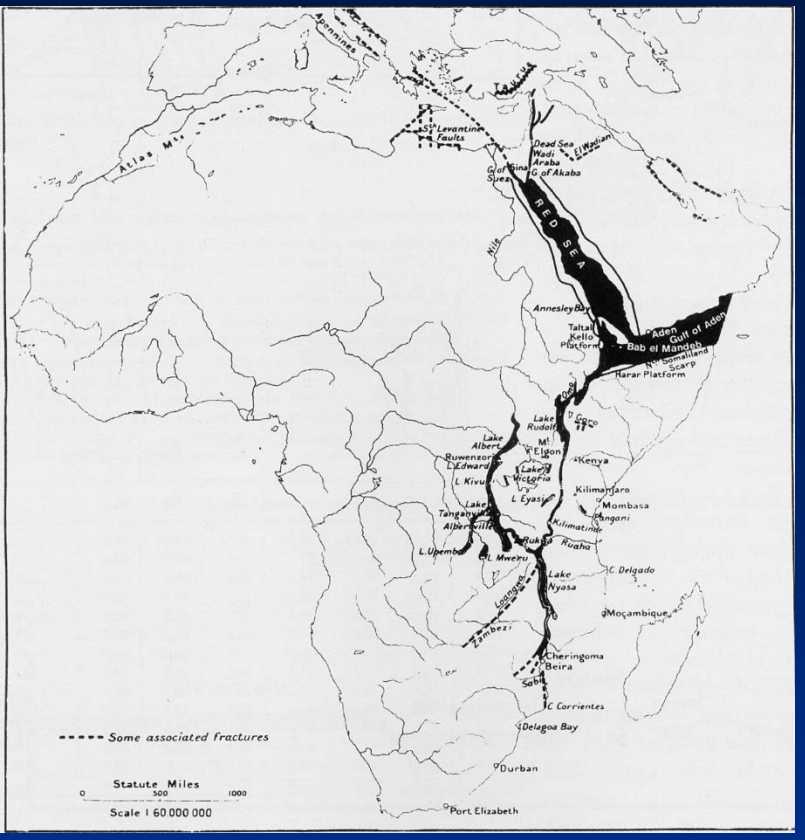
Afar, Etiopia, valle del Rift

Associazioni estensionali, ambienti geodinamici divergenti

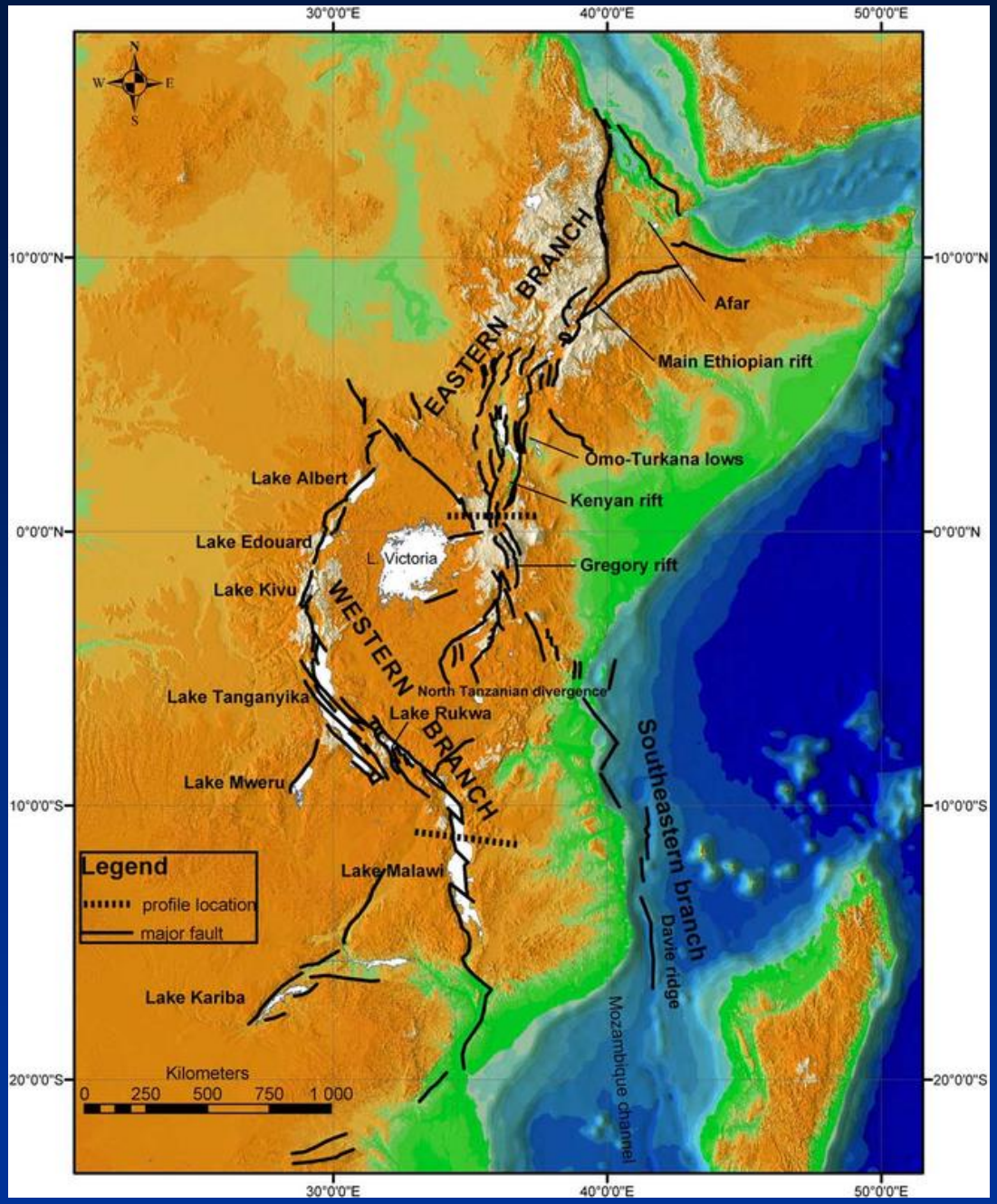
1a) estensione e assottigliamento crosta continentale che porta a crosta oceanica (*from rift to drift*)



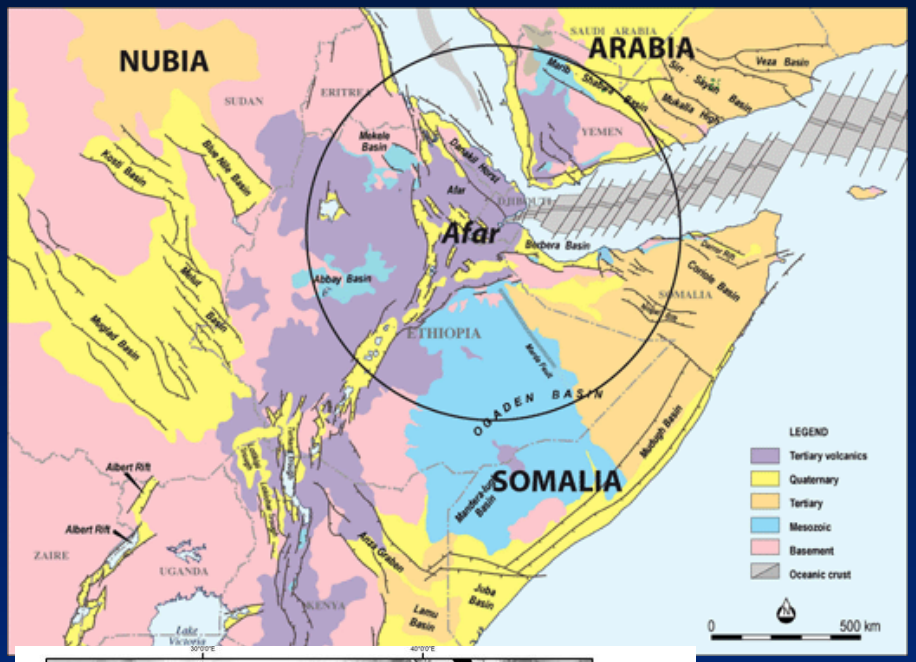
Da Earth from Space, NASA (eol.jsc.nasa.gov)



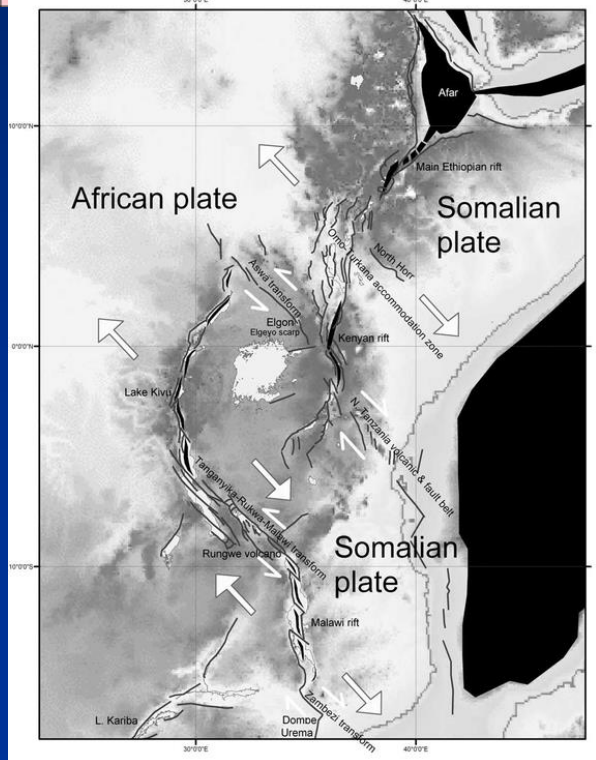
J. Gregory's 1920 map of the East African rift v.



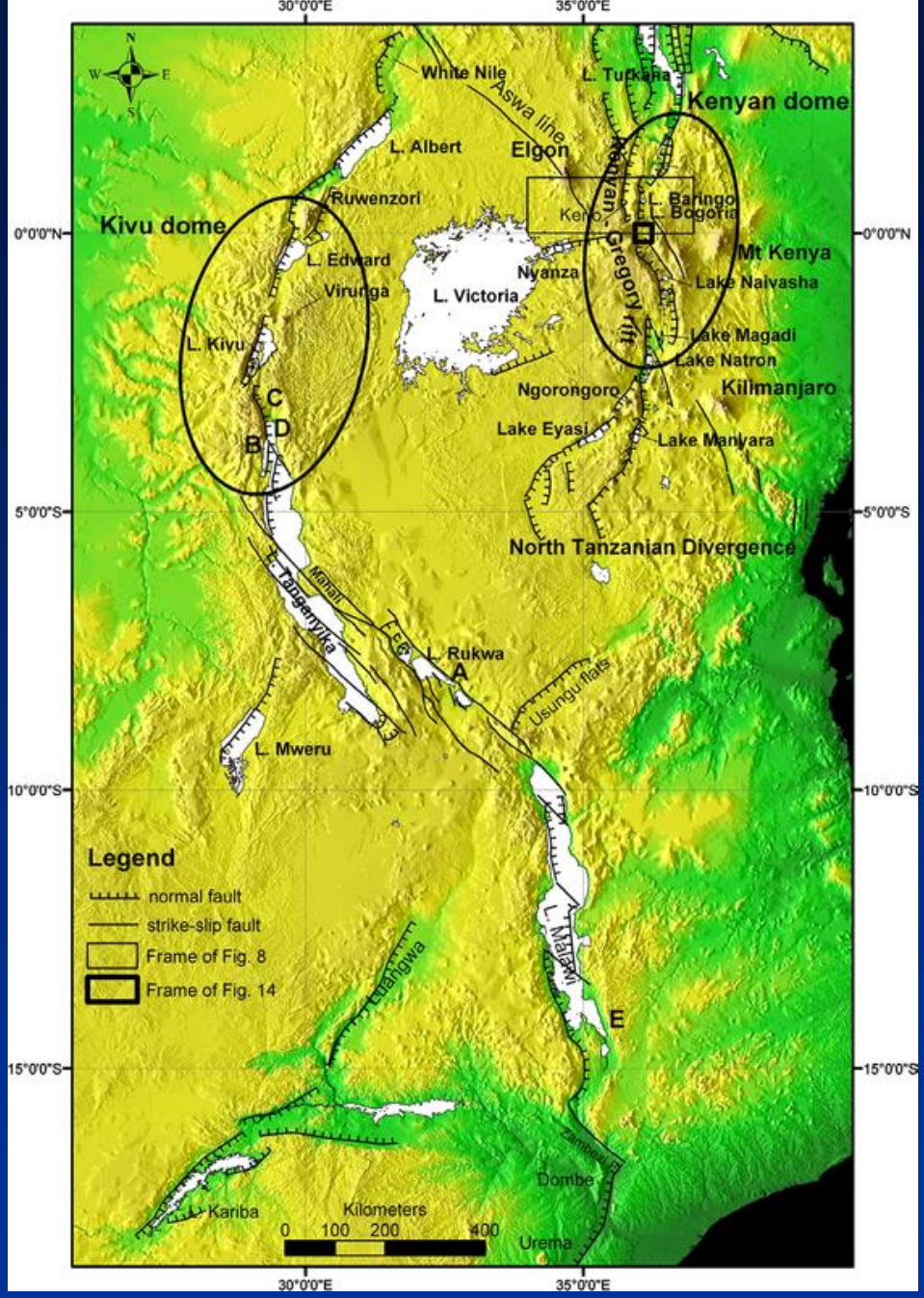
Chorowitz, 2005



Mège et al., 2015



Chorowitz, 2005



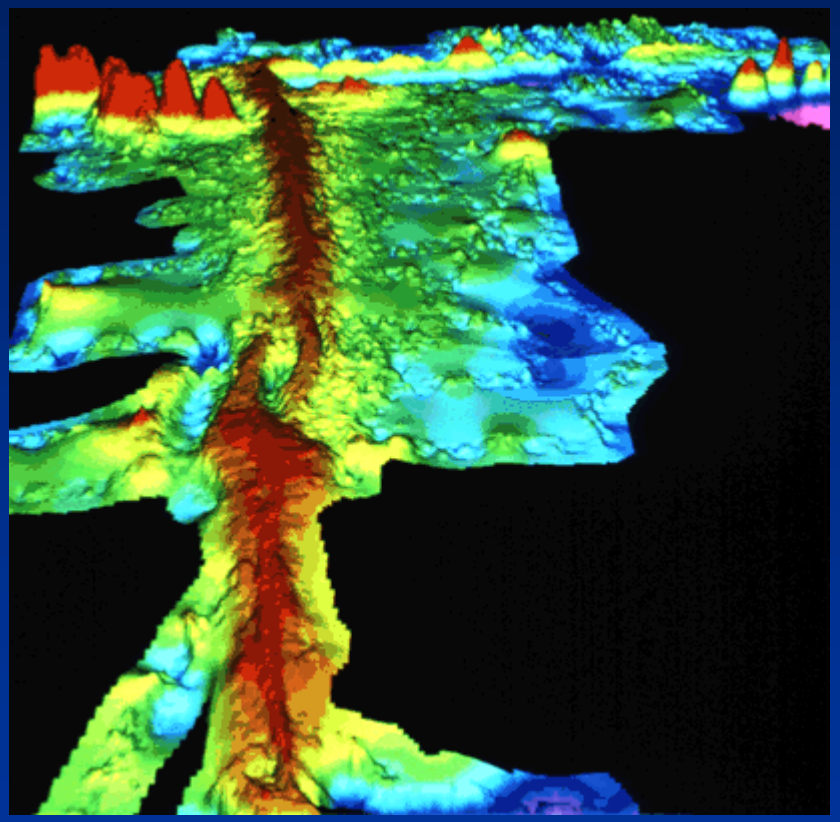
Chorowitz, 2005

associazioni estensionali, ambienti geodinamici divergenti

1b) formazione di crosta oceanica, dorsali !!

Da Oddur Sigurdsson, National Energy Authority, Iceland

Islanda, zona di dorsale

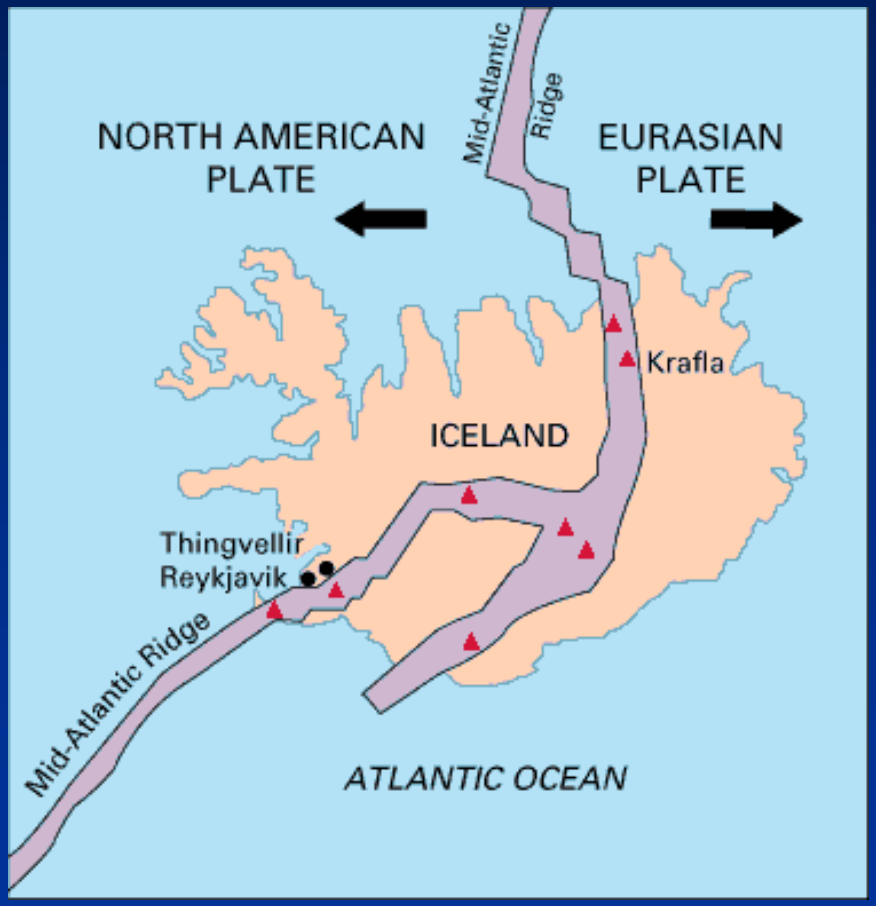


Zona di dorsale medio-atlantica

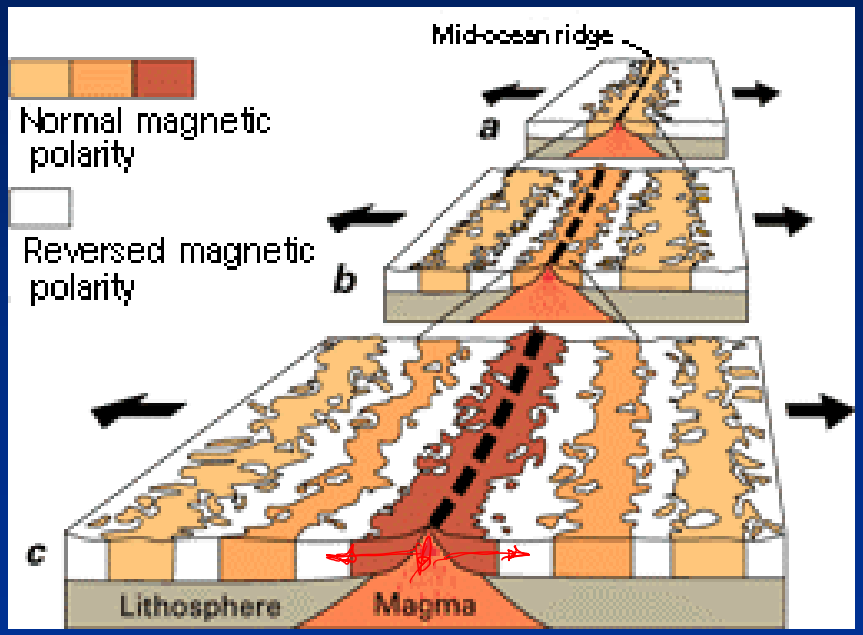
https://pubs.usgs.gov/gip/dynamic/topomap.html (from Stacey Tighe, University of Rhode Island)

associazioni estensionali, ambienti geodinamici divergenti

Formazione di crosta oceanica, dorsali !!



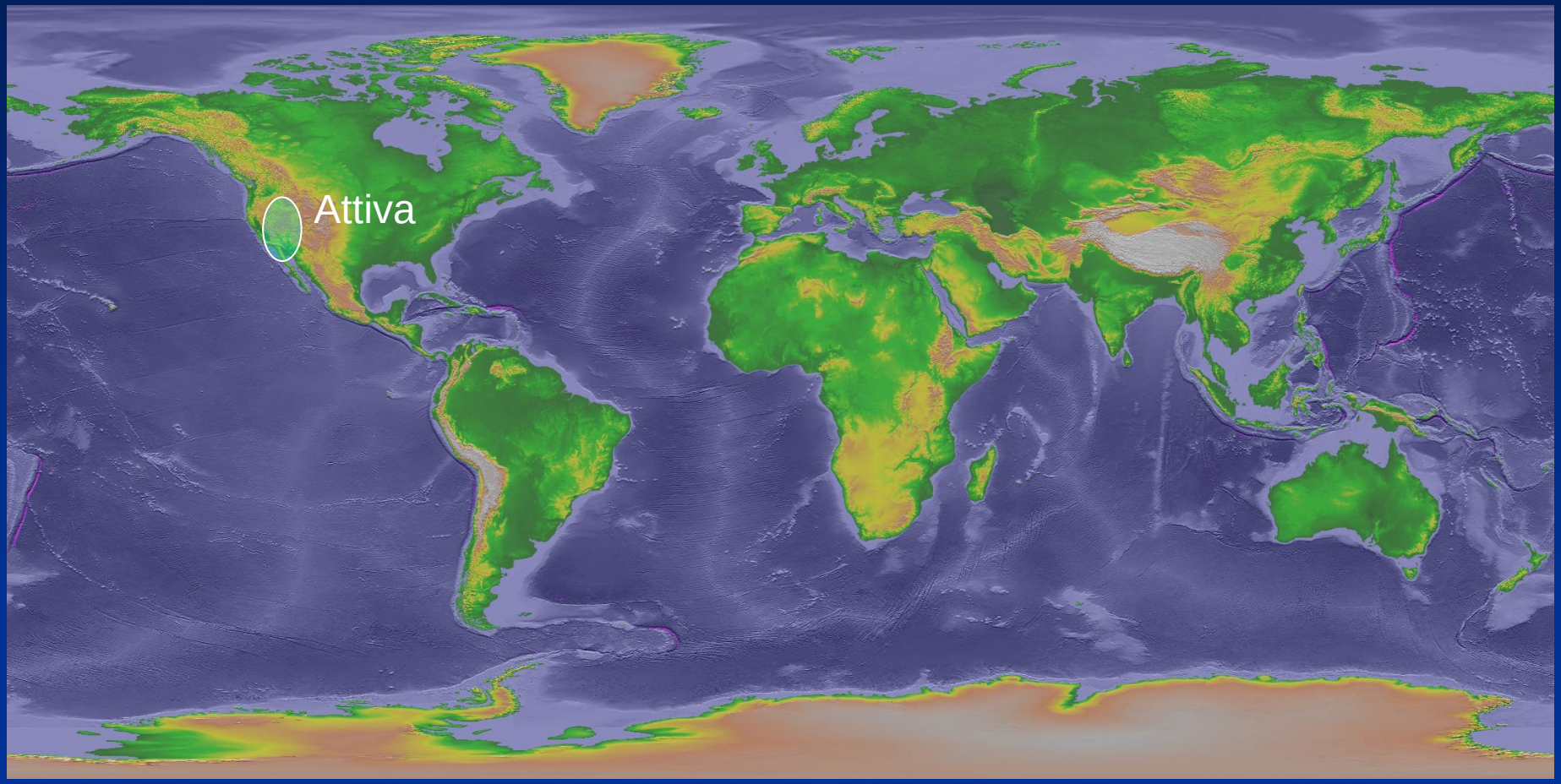
USGS: https://pubs.usgs.gov/gip/dynamic/understanding.html



http://factsanddetails.com/world/cat51/sub323/item2212.html

Associazioni di faglie normali

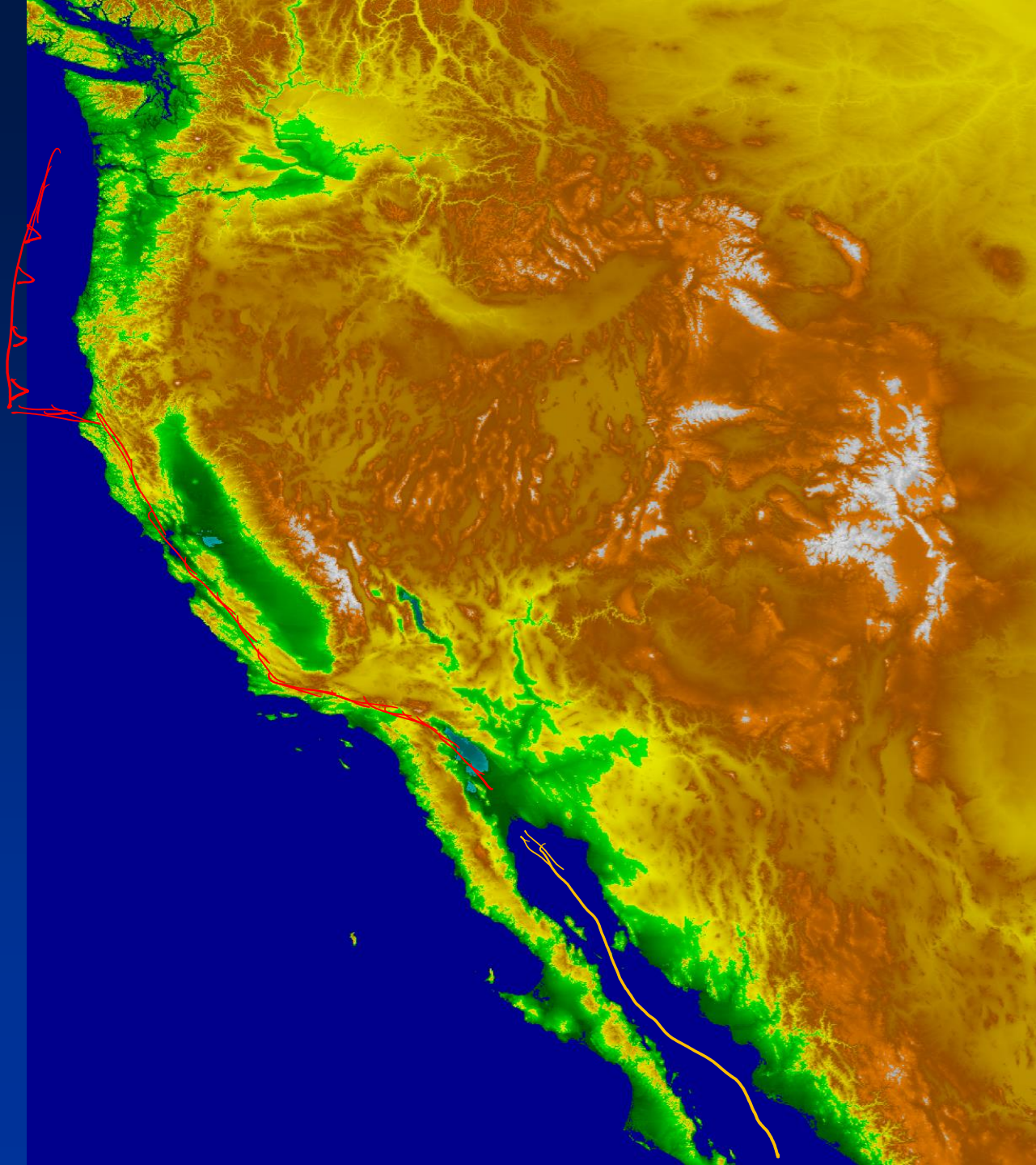
2a) associazioni estensionali in ambienti geodinamici divergenti prossimi a margini trascorrenti/convergenti

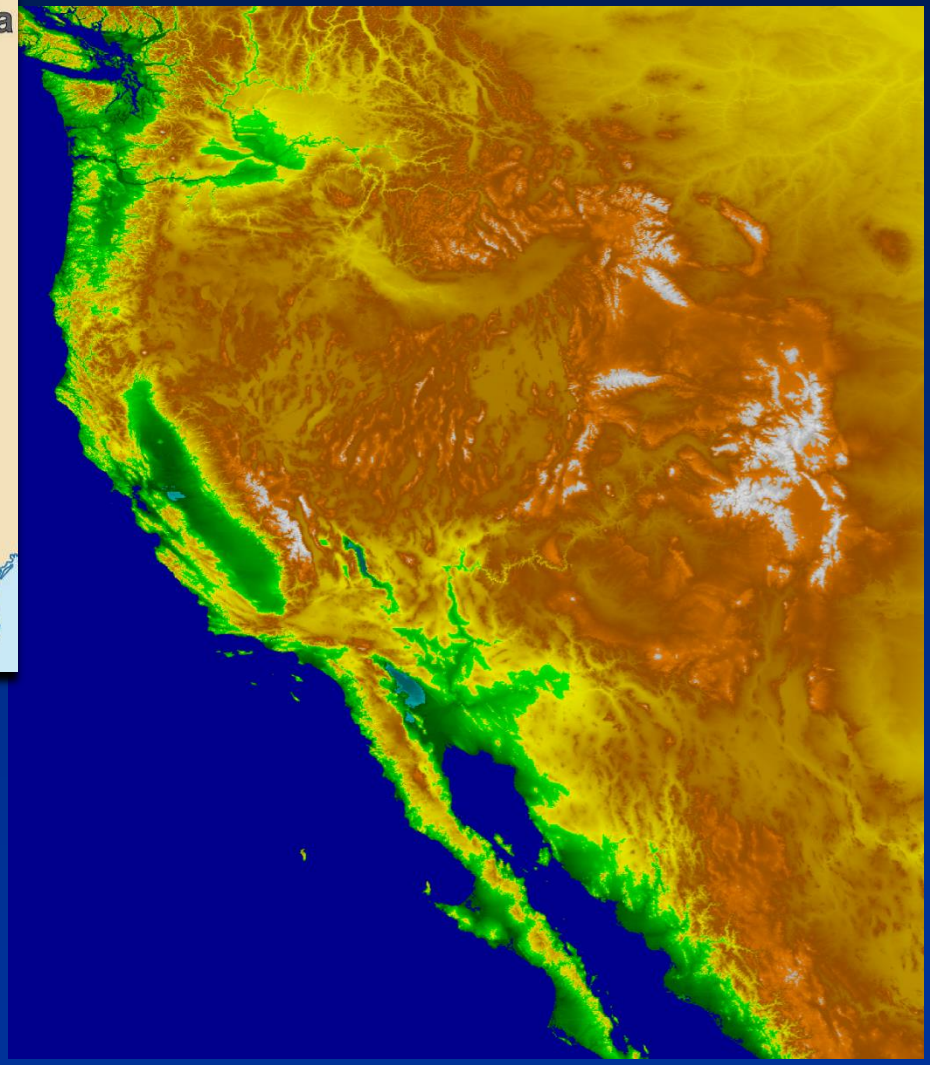


Associazioni estensionali in ambienti geodinamici divergenti prossimi a margini trascorrenti/

convergenti

Basin & Range, estensione intra-continentale

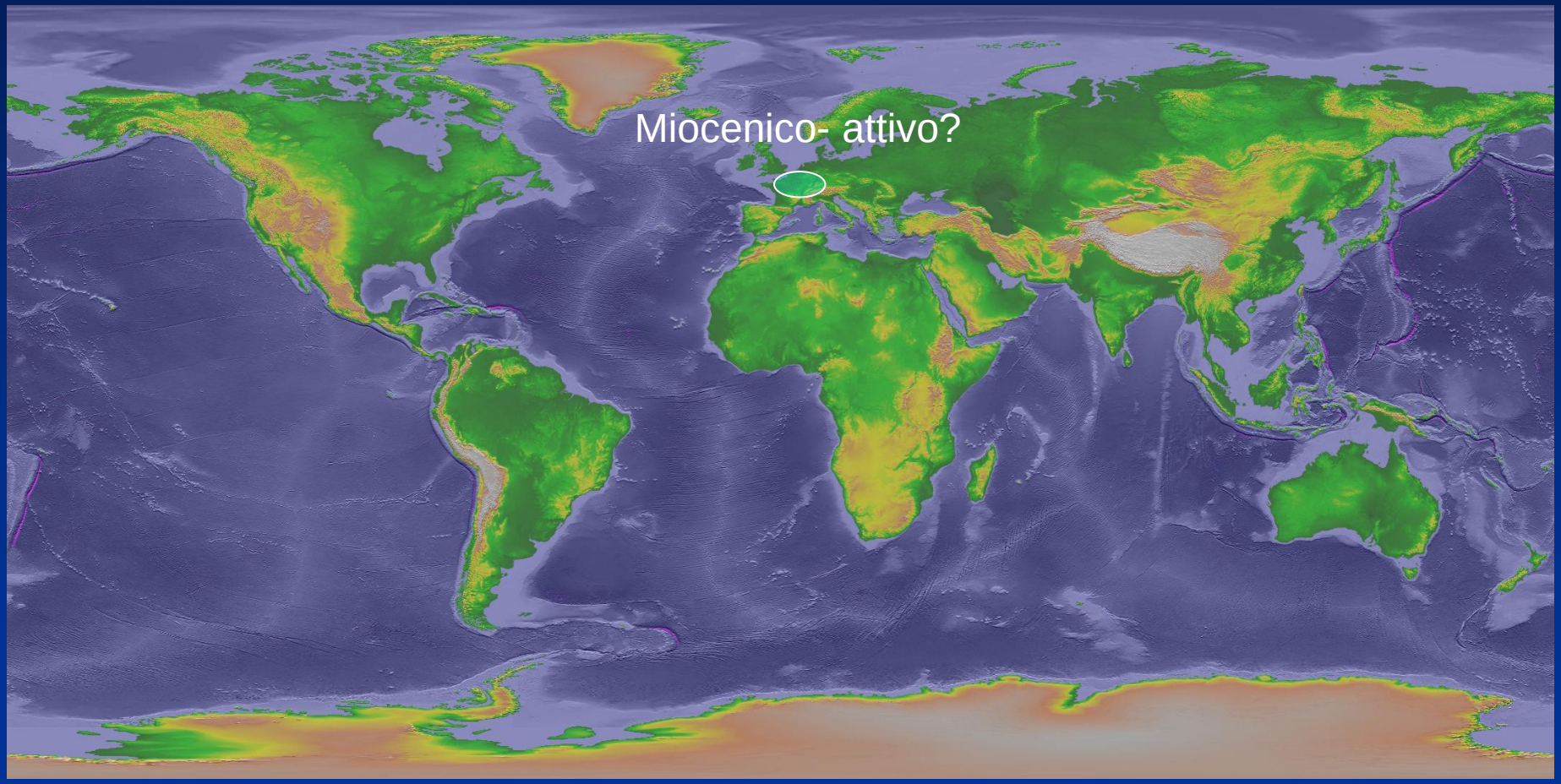




Basin & Range, estensione intra-continentale, situazione tettonica e geodinamica regionale

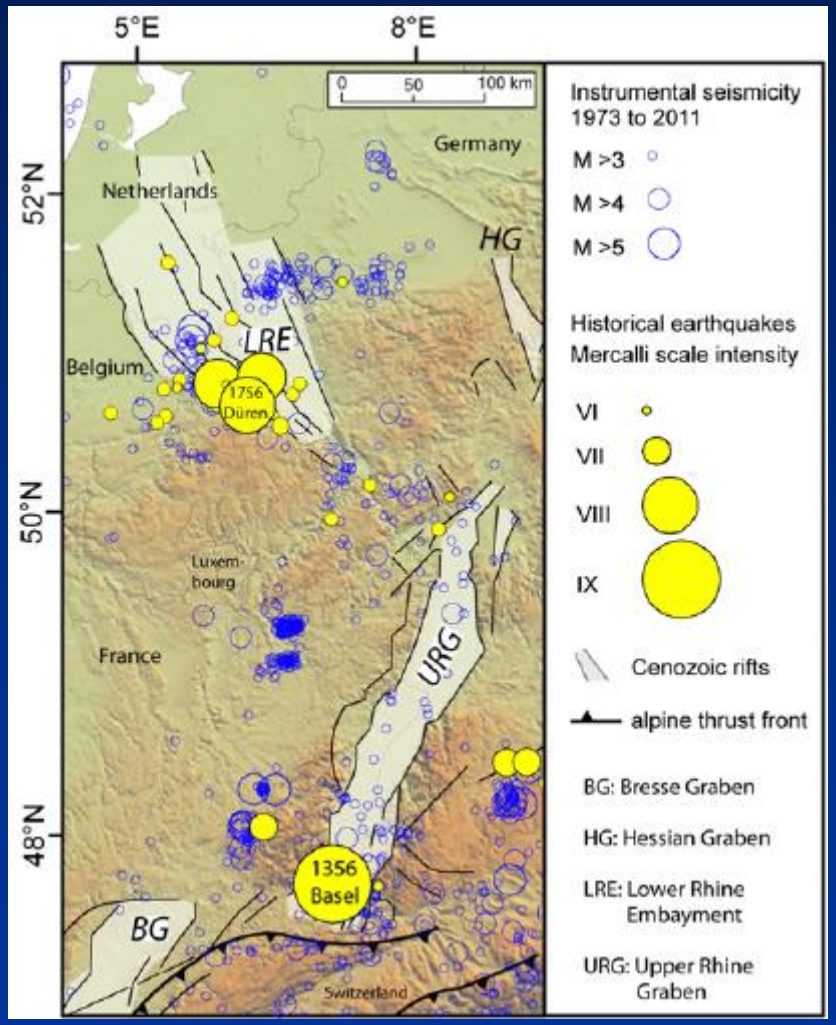
Associazioni di faglie normali

2b) associazioni estensionali in ambienti geodinamici divergenti prossimi a margini convergenti



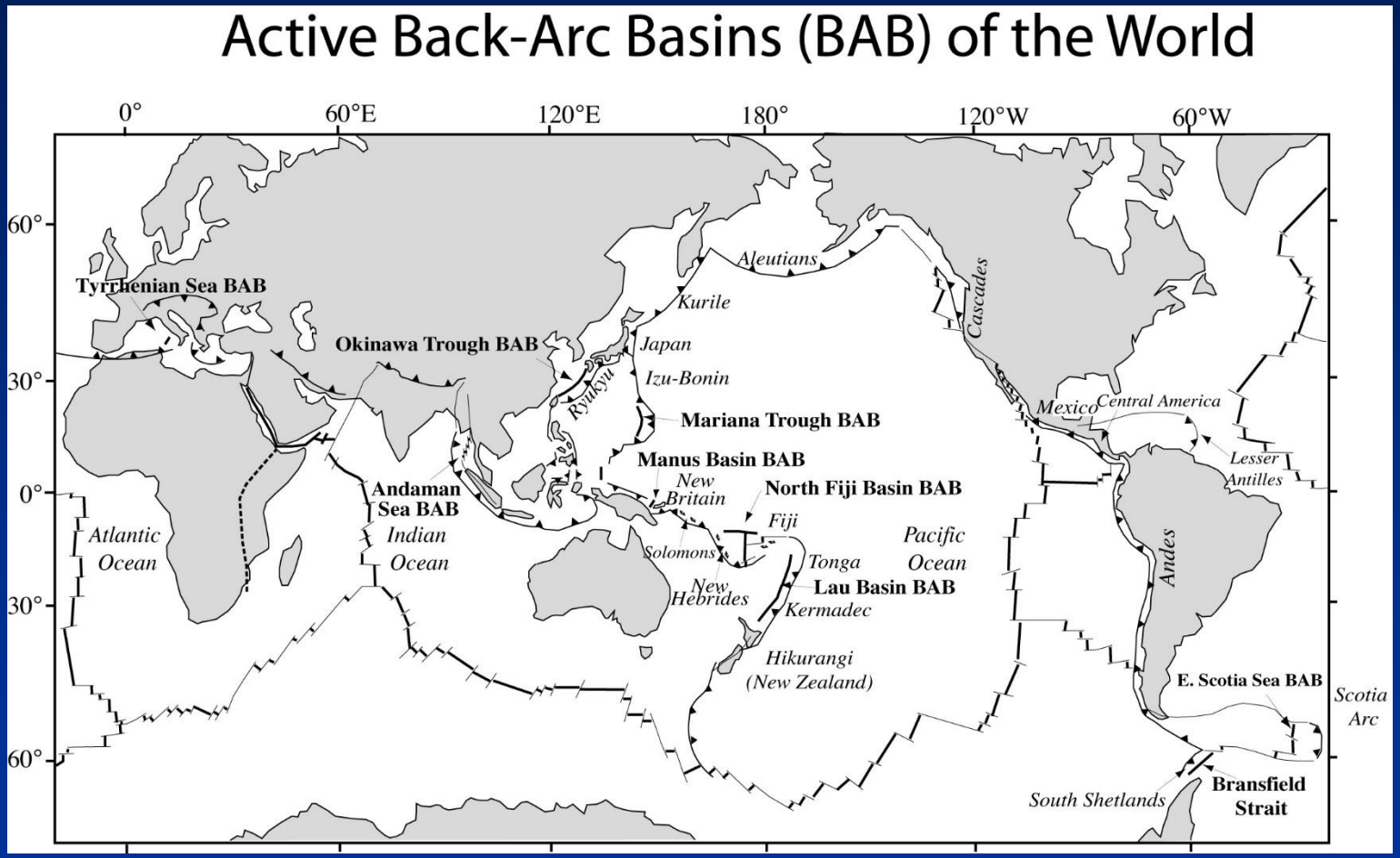
Associazioni estensionali in ambienti geodinamici divergenti prossimi a margini convergenti

https://en.wikipedia.org/wiki/European_Cenozoic_Rift_System



Associazioni di faglie normali

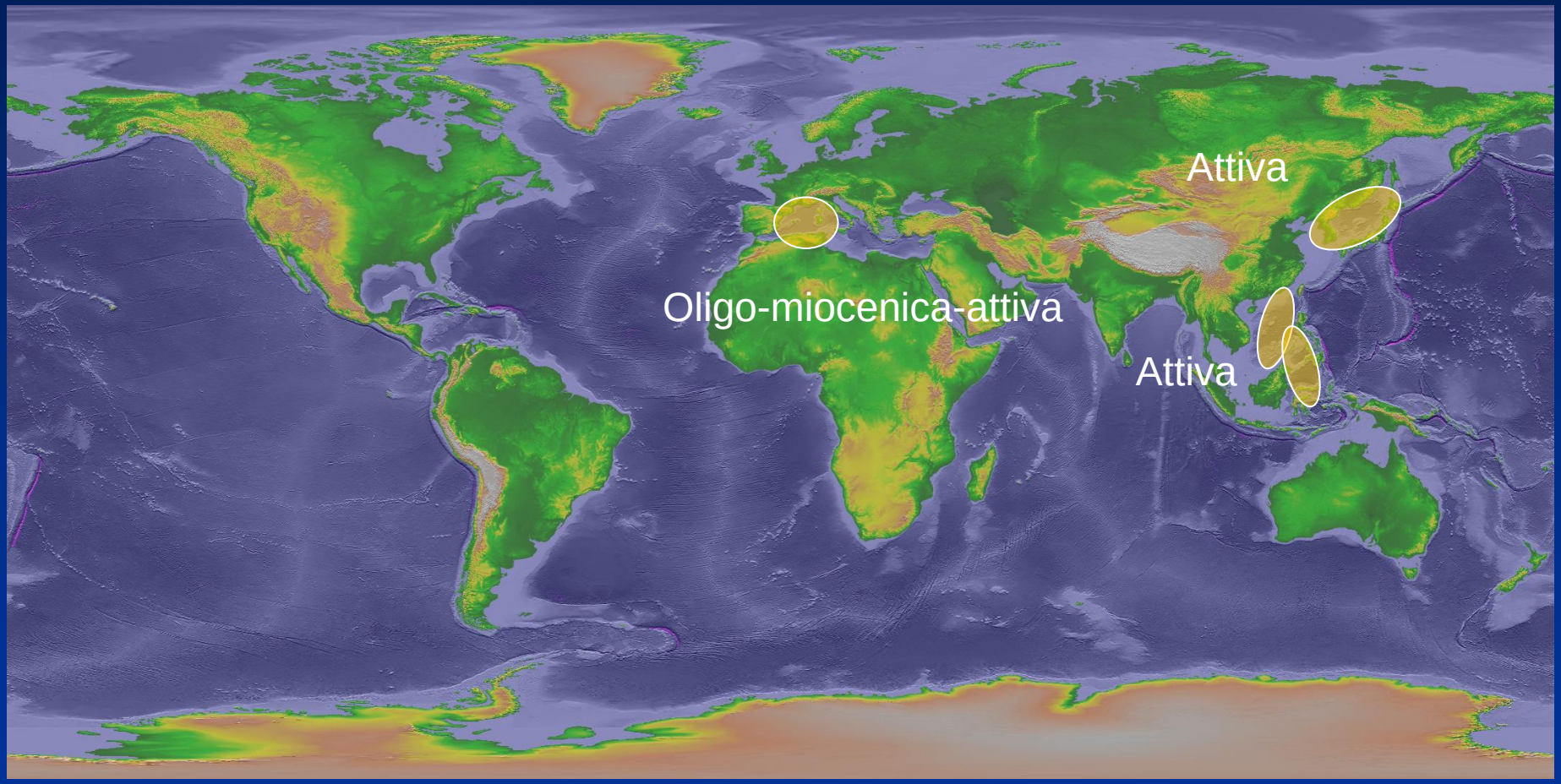
3) associazioni estensionali dovute ad ambienti geodinamici convergenti!!!



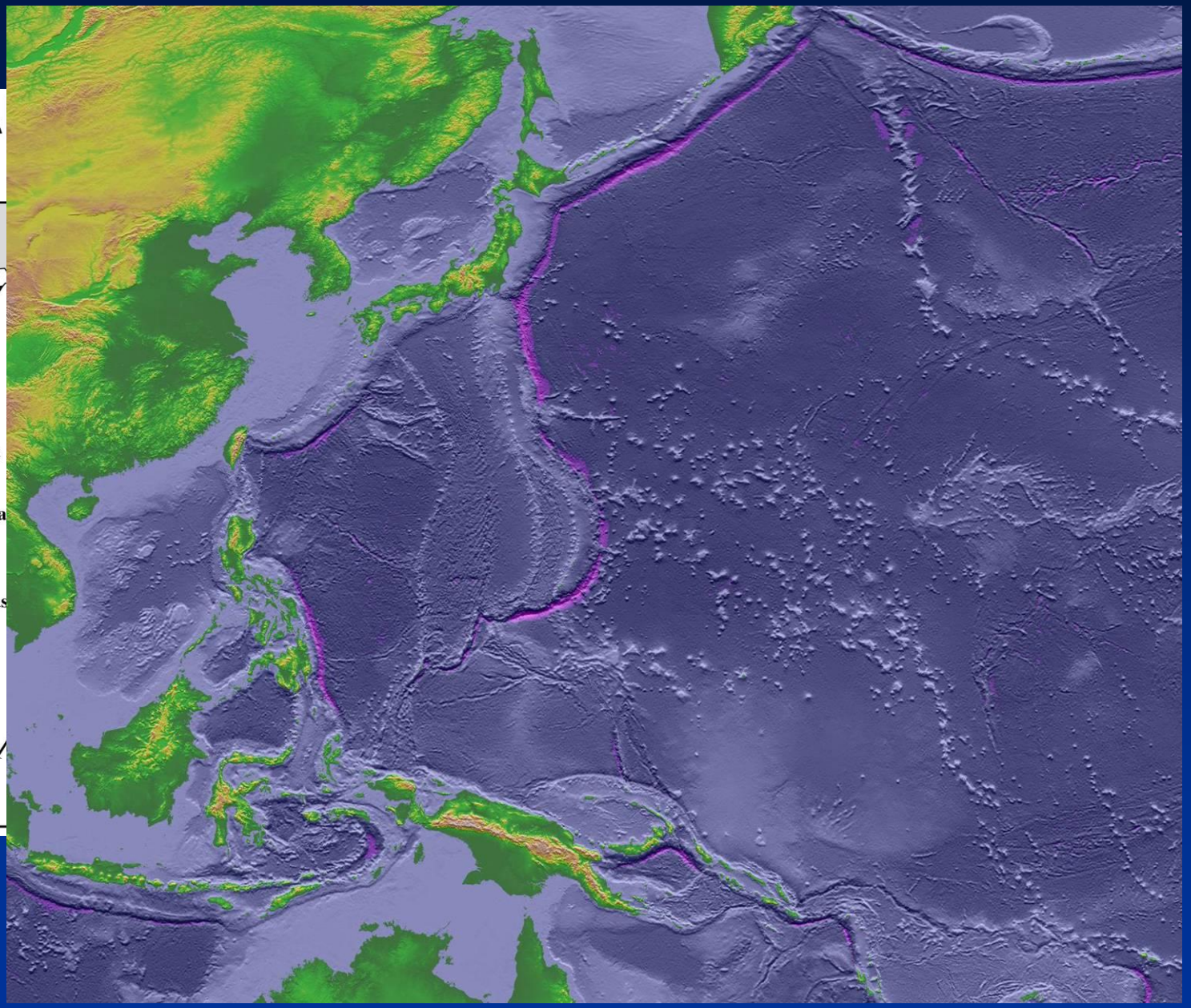
Da Wikipedia e da Guinot & Segonzac, 2017

3) associazioni estensionali dovute ad ambienti geodinamici convergenti:

Estesi bacini di retroarco

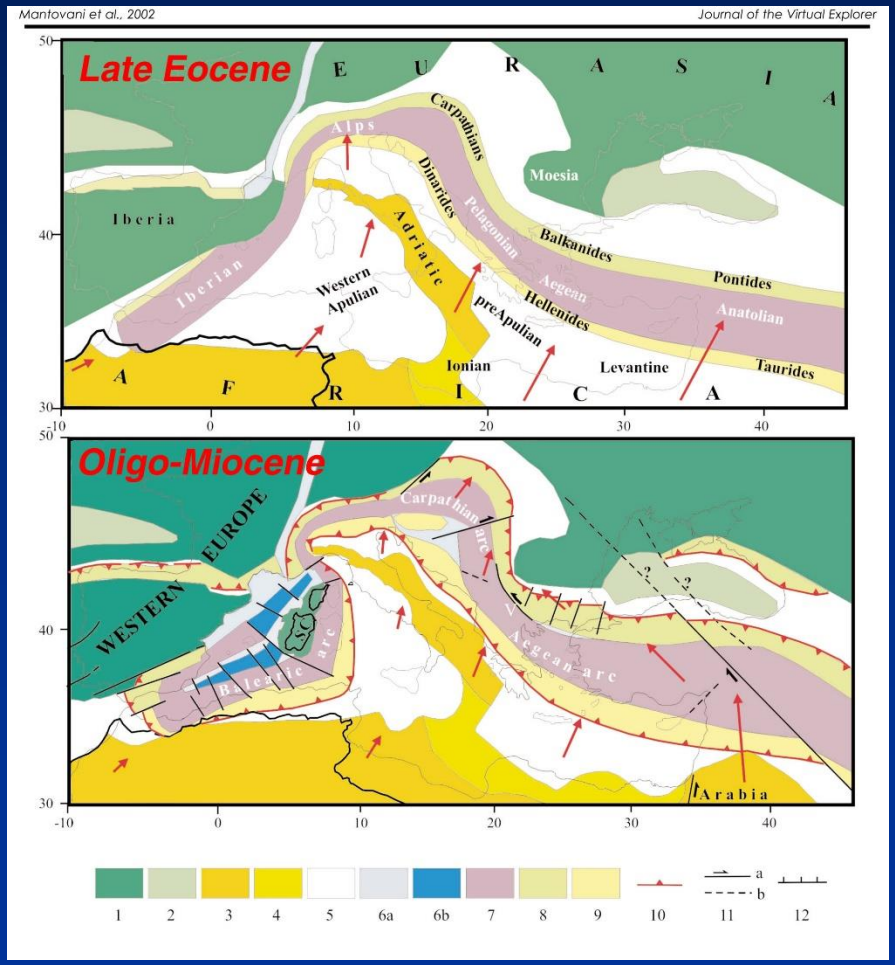


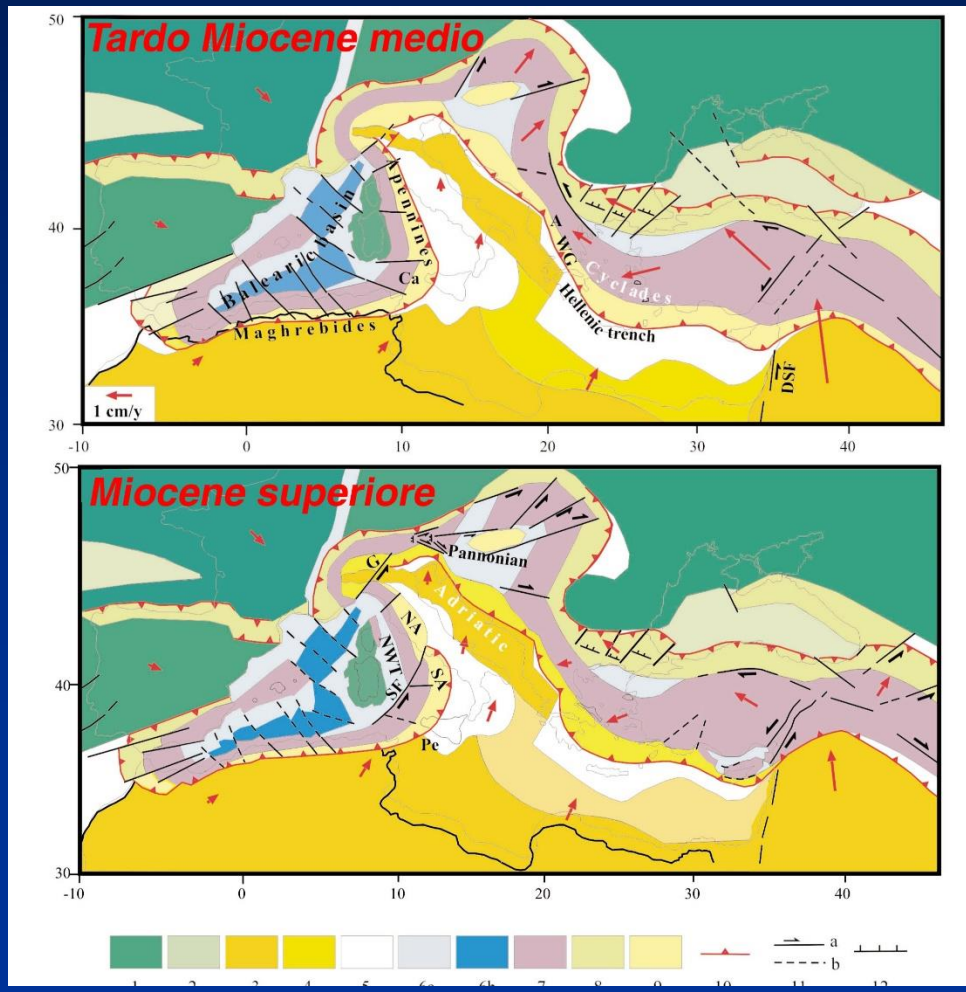

k-Arc Basins (BA
120°E
180°
Aleutians
Kurile
BAB
Japan
Izu-Bonin
Ryukyu
Mariana Trough BAB
Manus Basin BAB
New Britain
North Fiji Ba
Fiji
Solomons
Tonga
New Hebrides
Lau Bas
Kermadec
Hikurangi
(New Zealand)



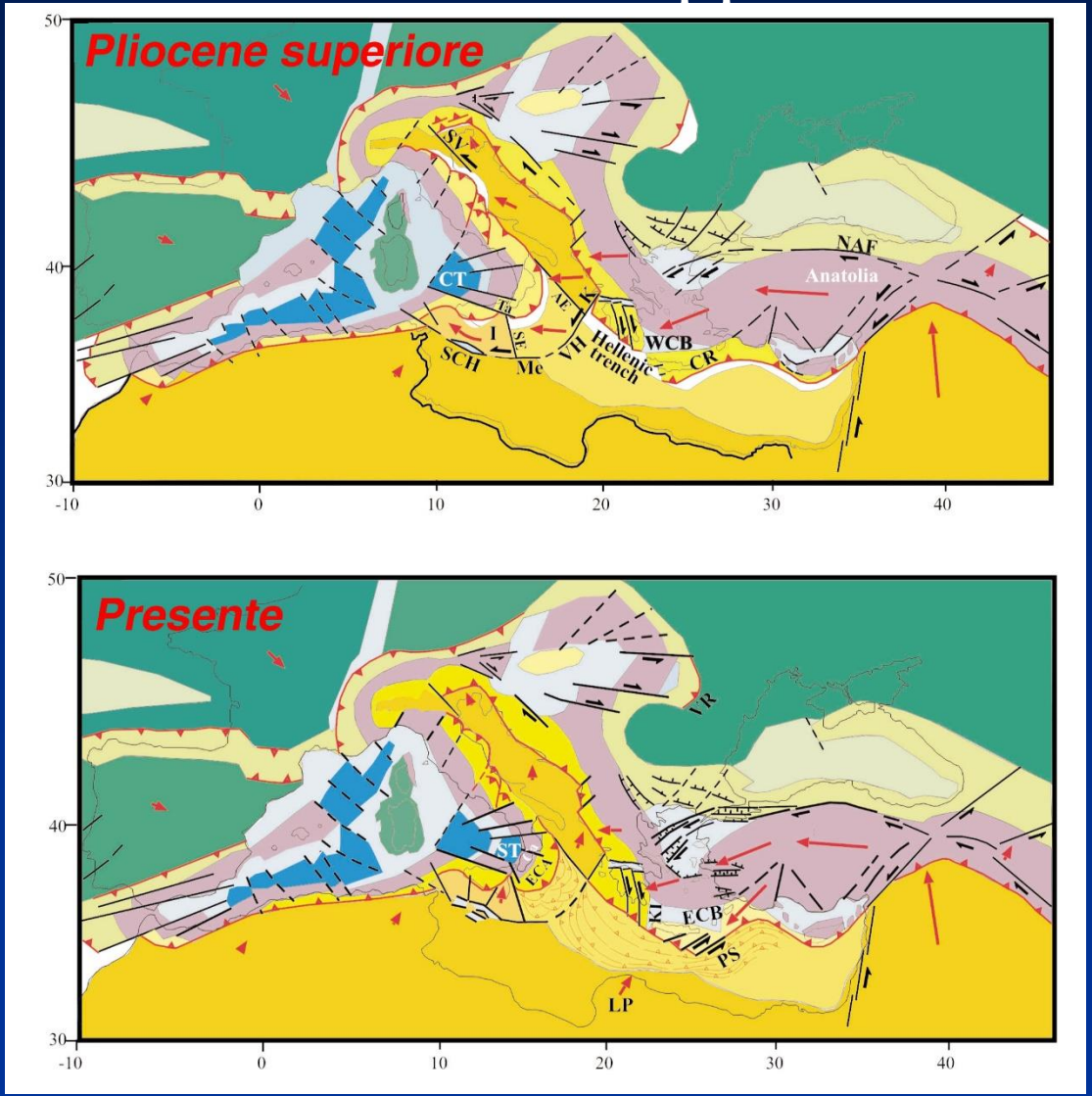
associazioni estensionali dovute ad ambienti geodinamici convergenti: evoluzione oligo-miocenica sino all'Attuale dell'Appennino

Da Mantovani et al., 2002

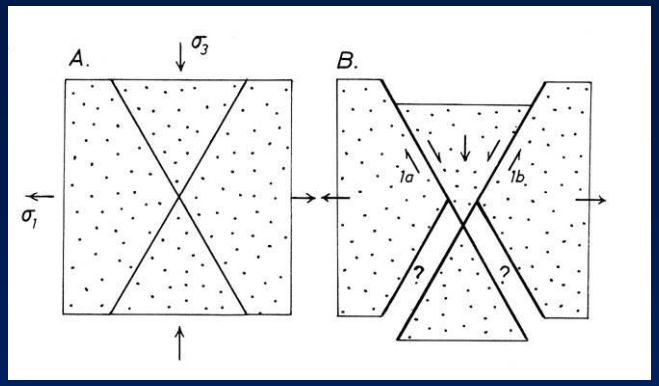




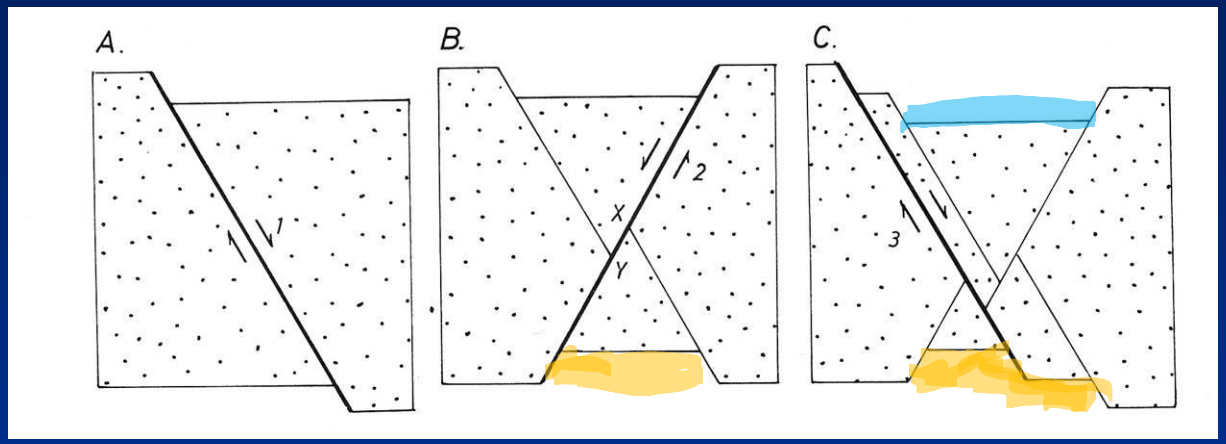
associazioni estensionali dovute ad ambienti geodinamici convergenti: evoluzione oligo-miocenica sino all'Attuale dell'Appennino



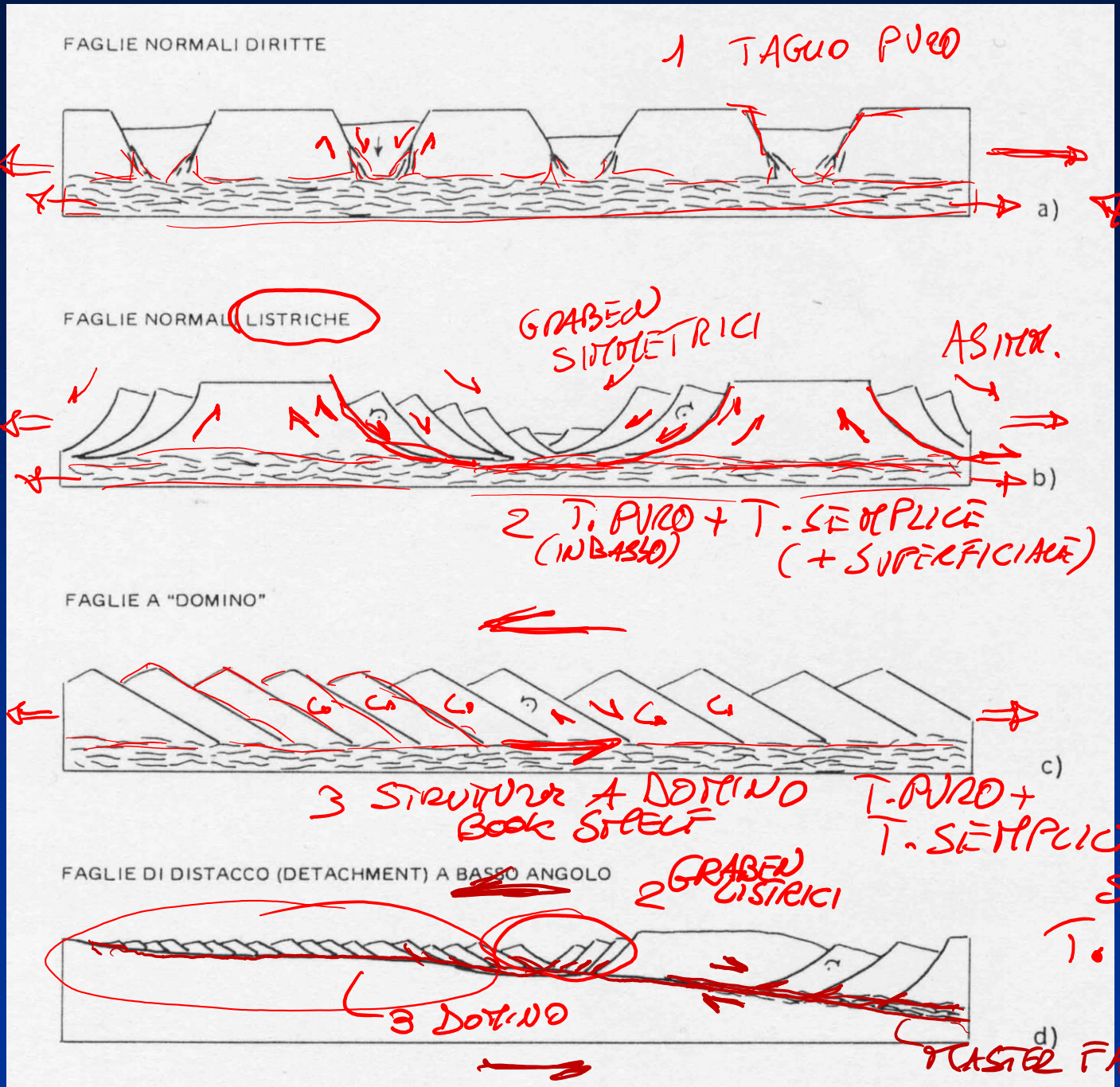
Da Mantovani et al., 2002



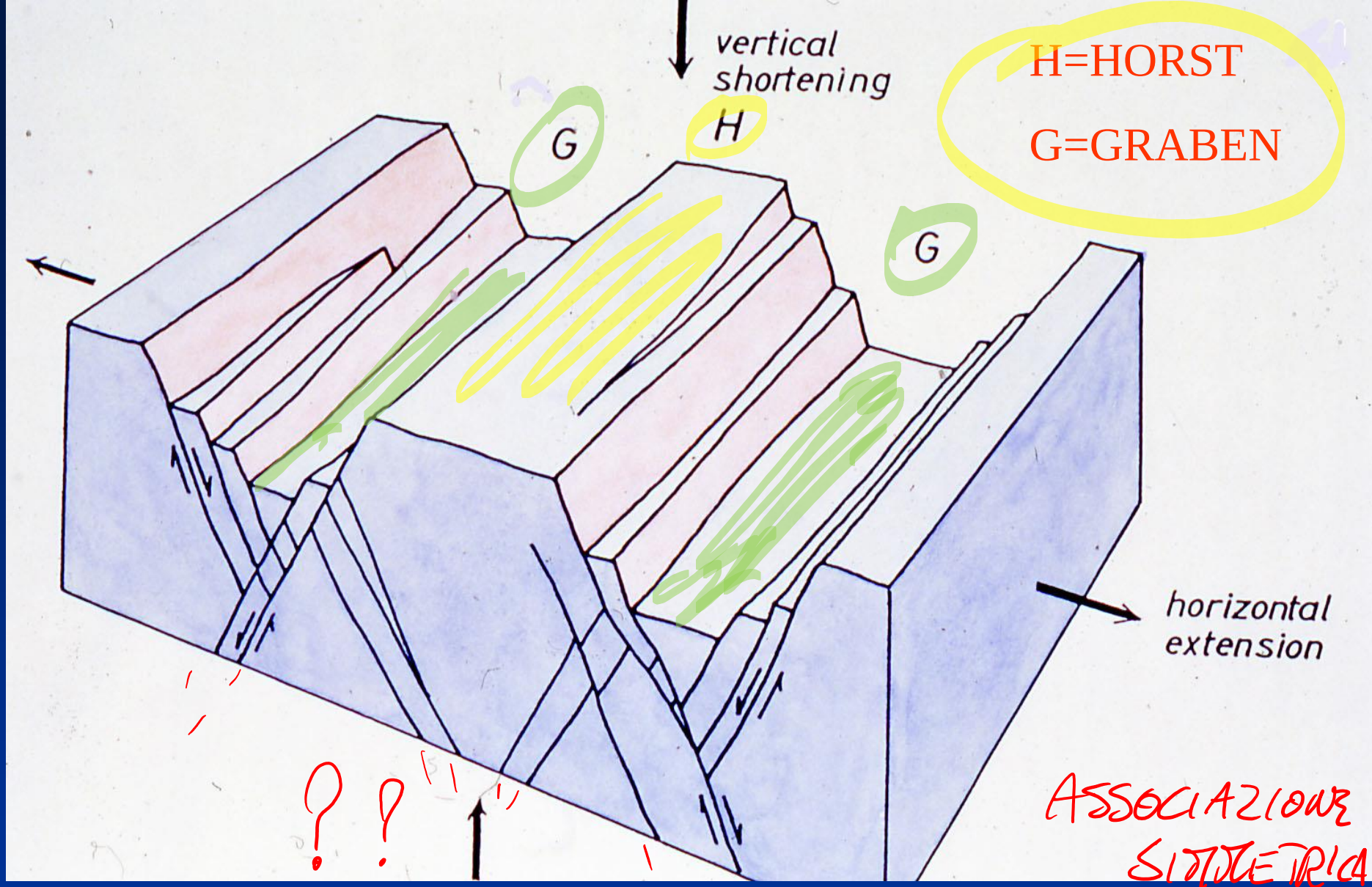
Da Ramsay and Huber, 1987



Solo le associazioni di faglie (coniugate) lavorano!!



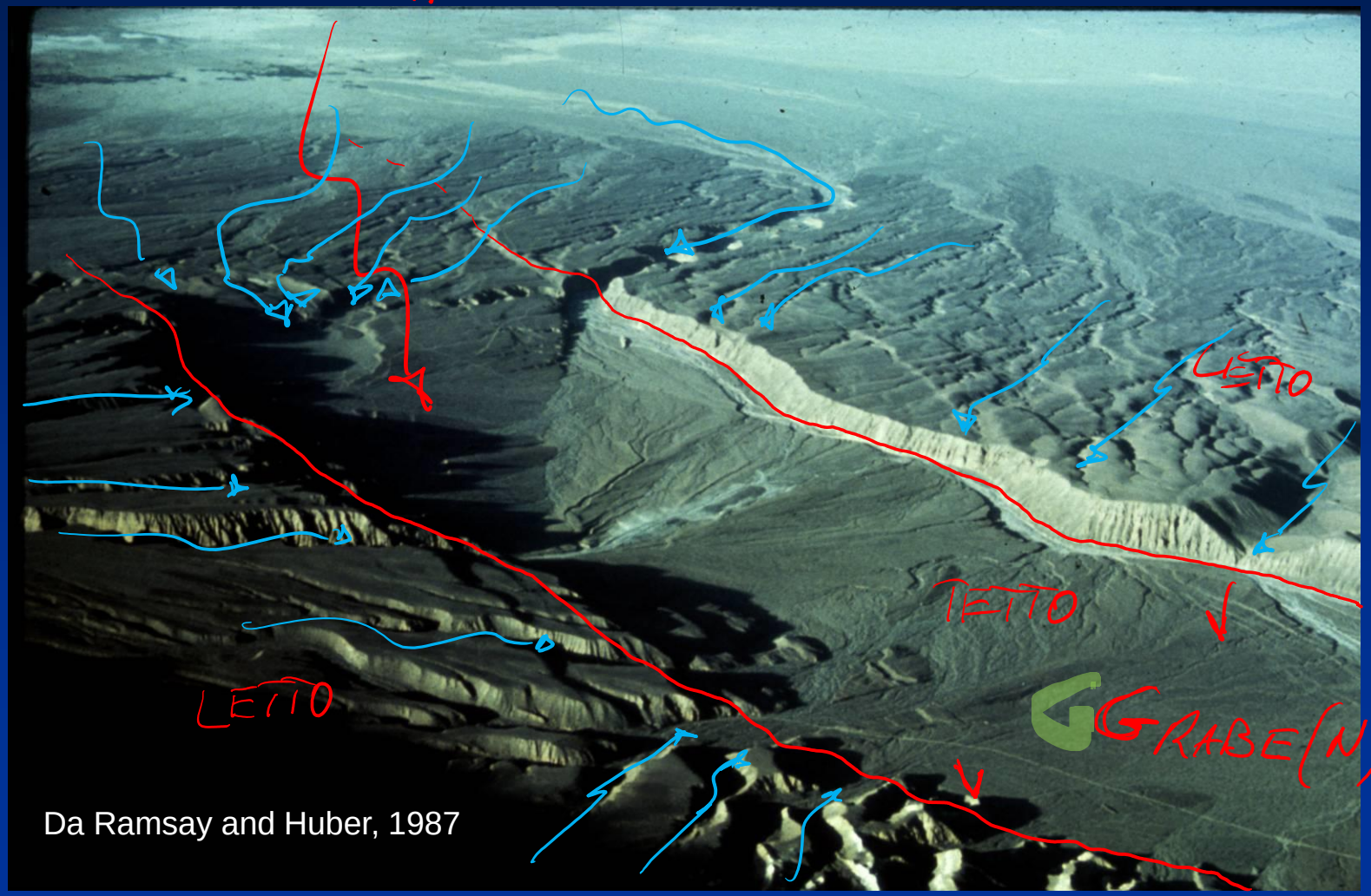
Sistemi di faglie normali: il problema della continuazione in profondità. Diverse geometrie in superficie e diversi modelli concettuali



Da Ramsay and Huber, 1987

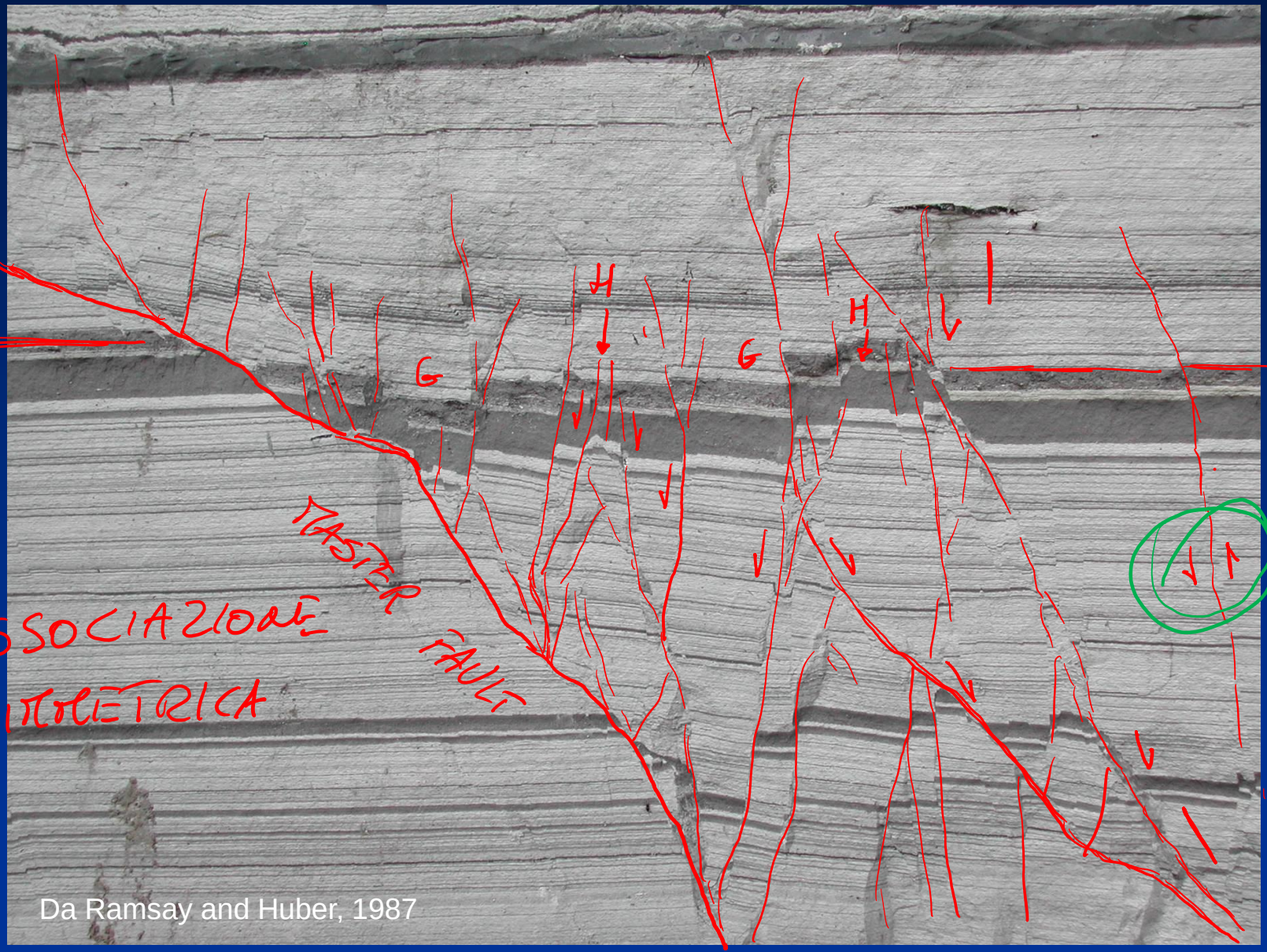
FAGLIE PIANE

Esempio di grabe (singola fossa) recentissimo e, presumibilmente, attivo



Da Ramsay and Huber, 1987

Sistemi di faglie normali: coniugate, faglia principale (master fault) e faglie curve!



Da Ramsay and Huber, 1987

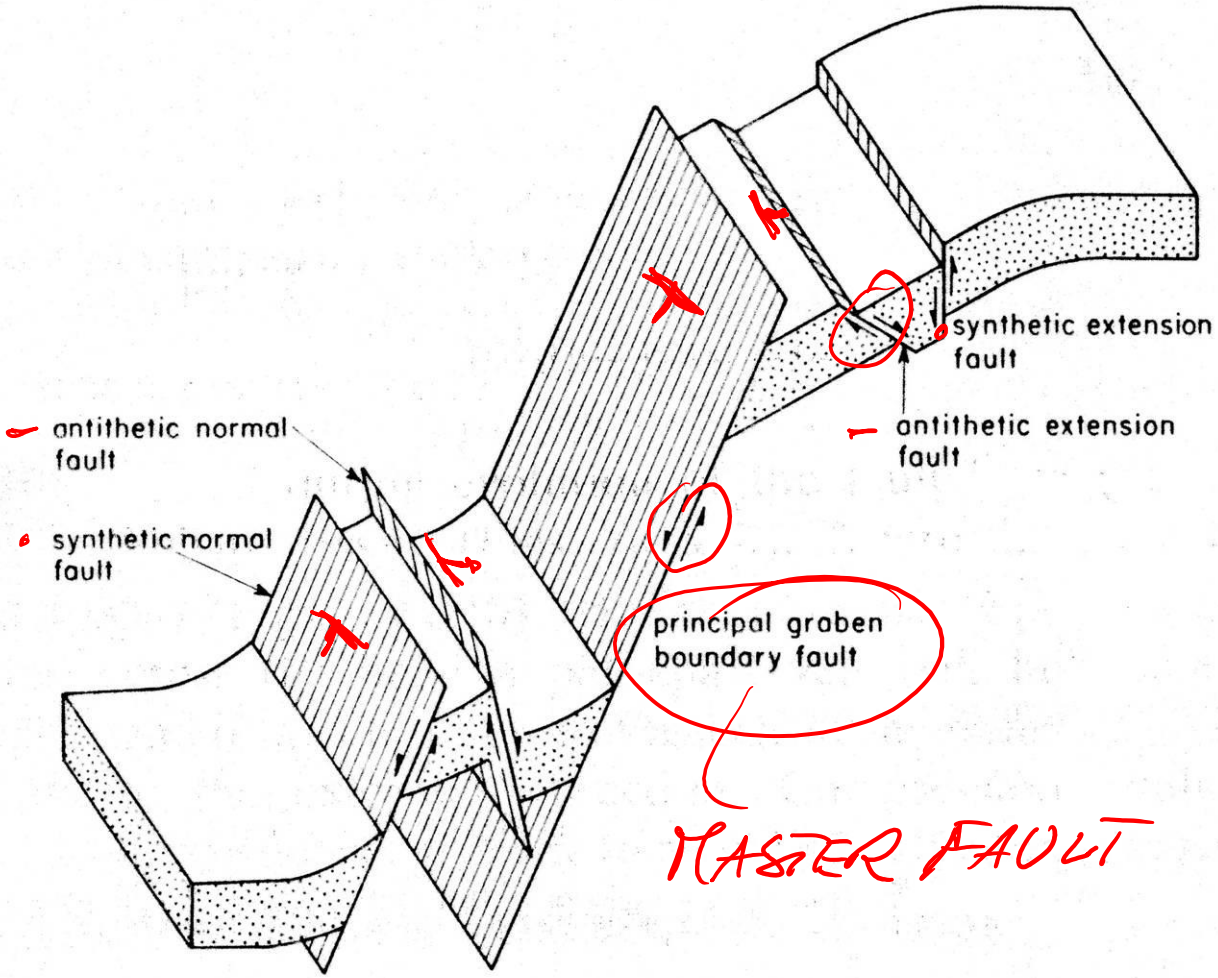


Fig. 6. Structures characteristic of planar high-angle normal fault zones such as those bounding grabens in terrains that have been inhomogeneously extended by a small percentage. After Al Kadhi & Hancock (1980, fig. 6).

FAGLIE CONIUGATE.

FAGLIA PRINCIPALE (MASTER FAULT)

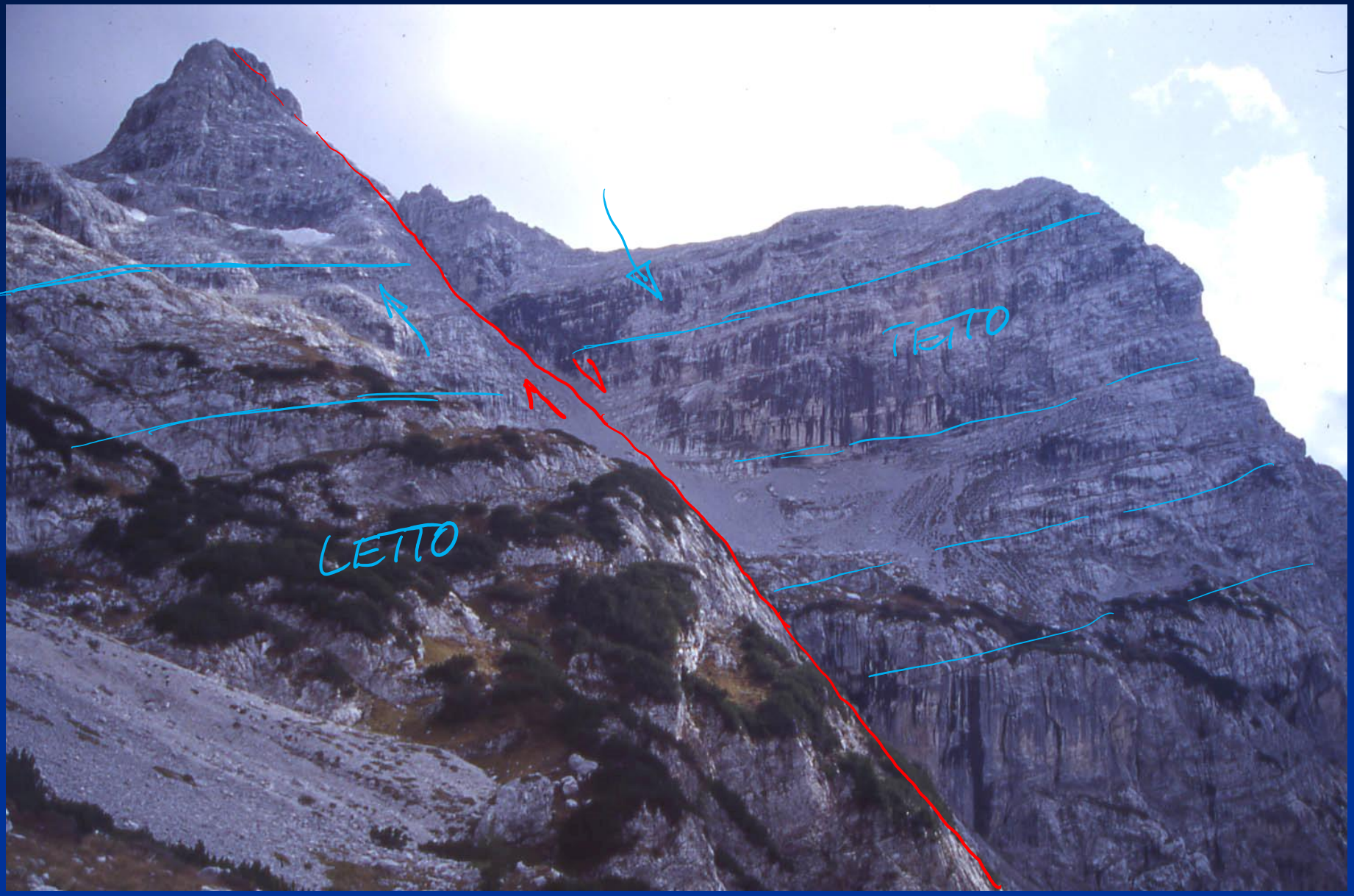
Sistemi di faglie normali coniugate: faglia principale, faglie antitetiche e sintetiche

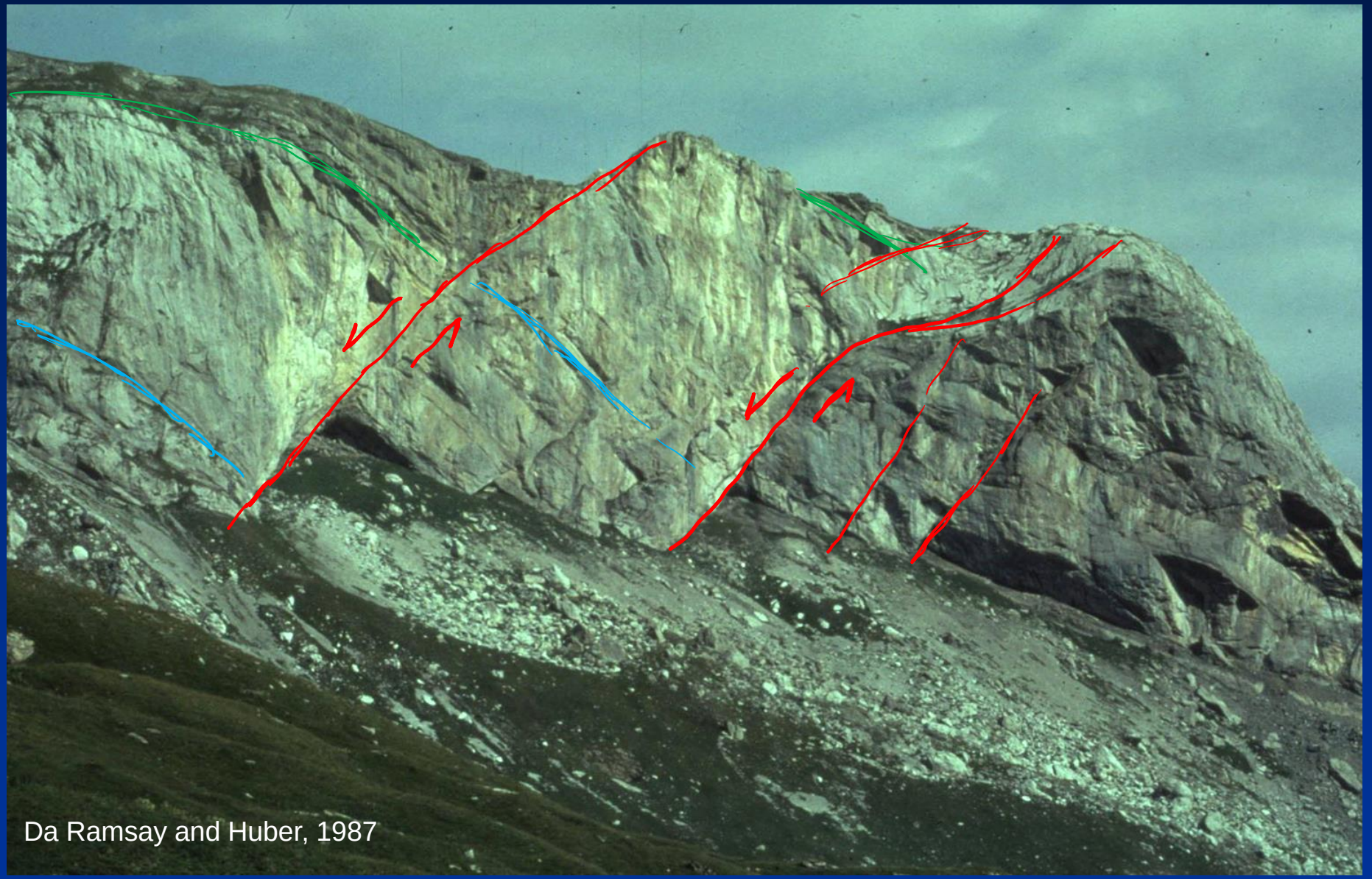
SIST. ASIMMETRICO

- FAGLIE SINTETICHE
- F. ANTITETICHE

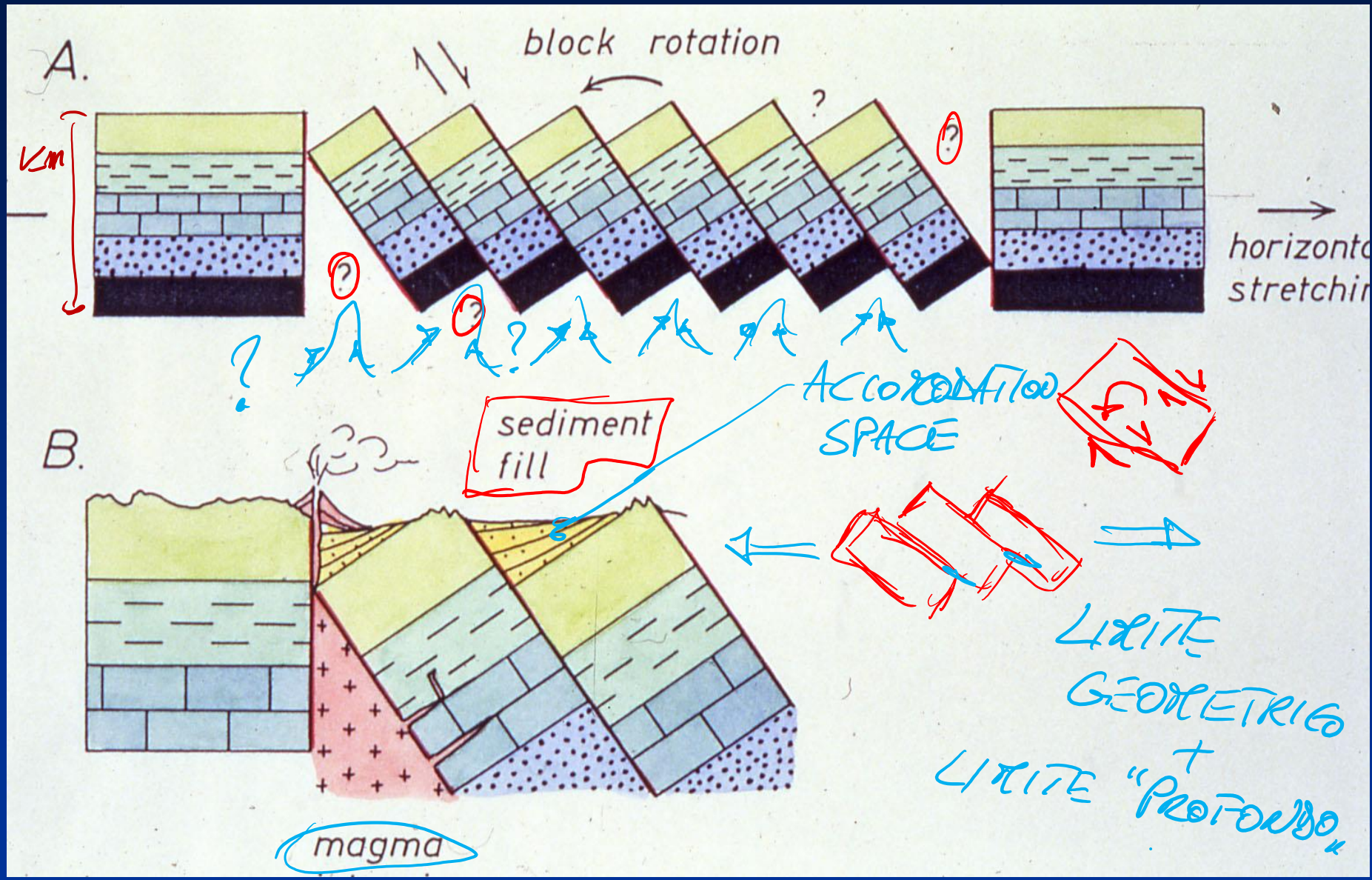
Da Hancock, 1985

Come si vede in affioramento una faglia normale?
(foto L. Selli)




Da Ramsay and Huber, 1987

Sistemi di faglie normali coniugate sintetiche; sistema a domino!



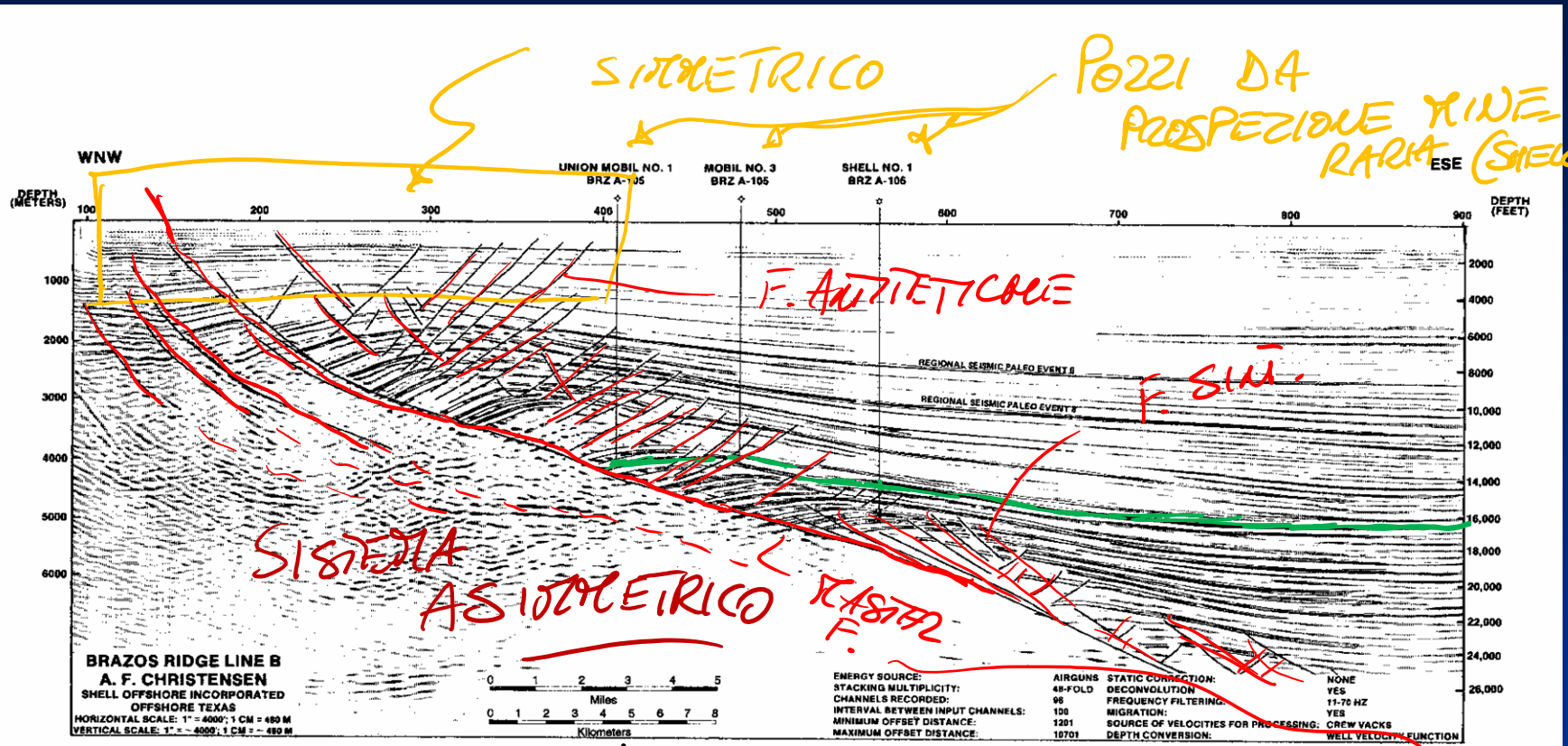
Da Ramsay and Huber, 1987

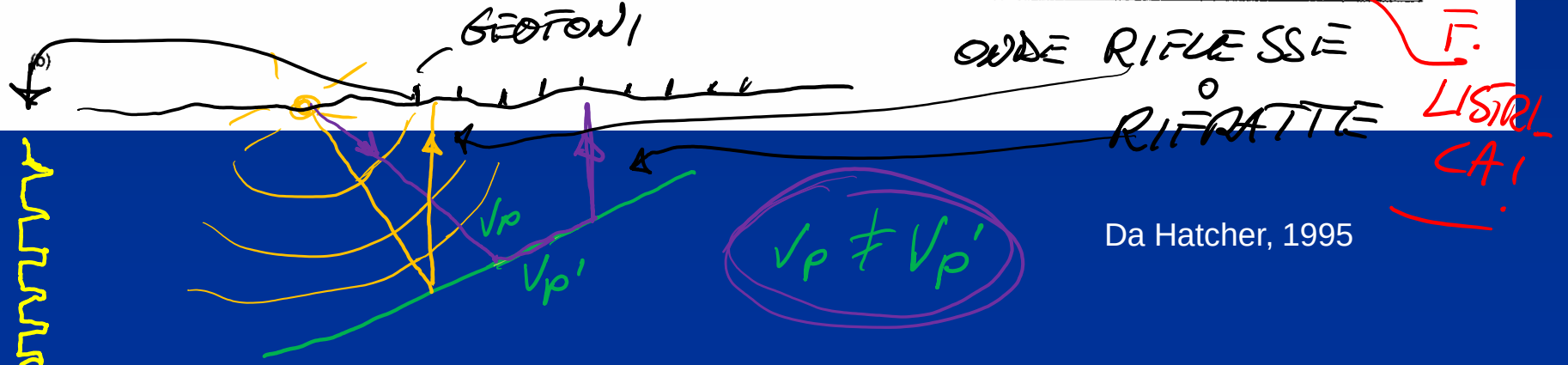
Sistemi di faglie normali coniugate sintetiche; sistema a domino!

Da Ramsay and Huber, 1987

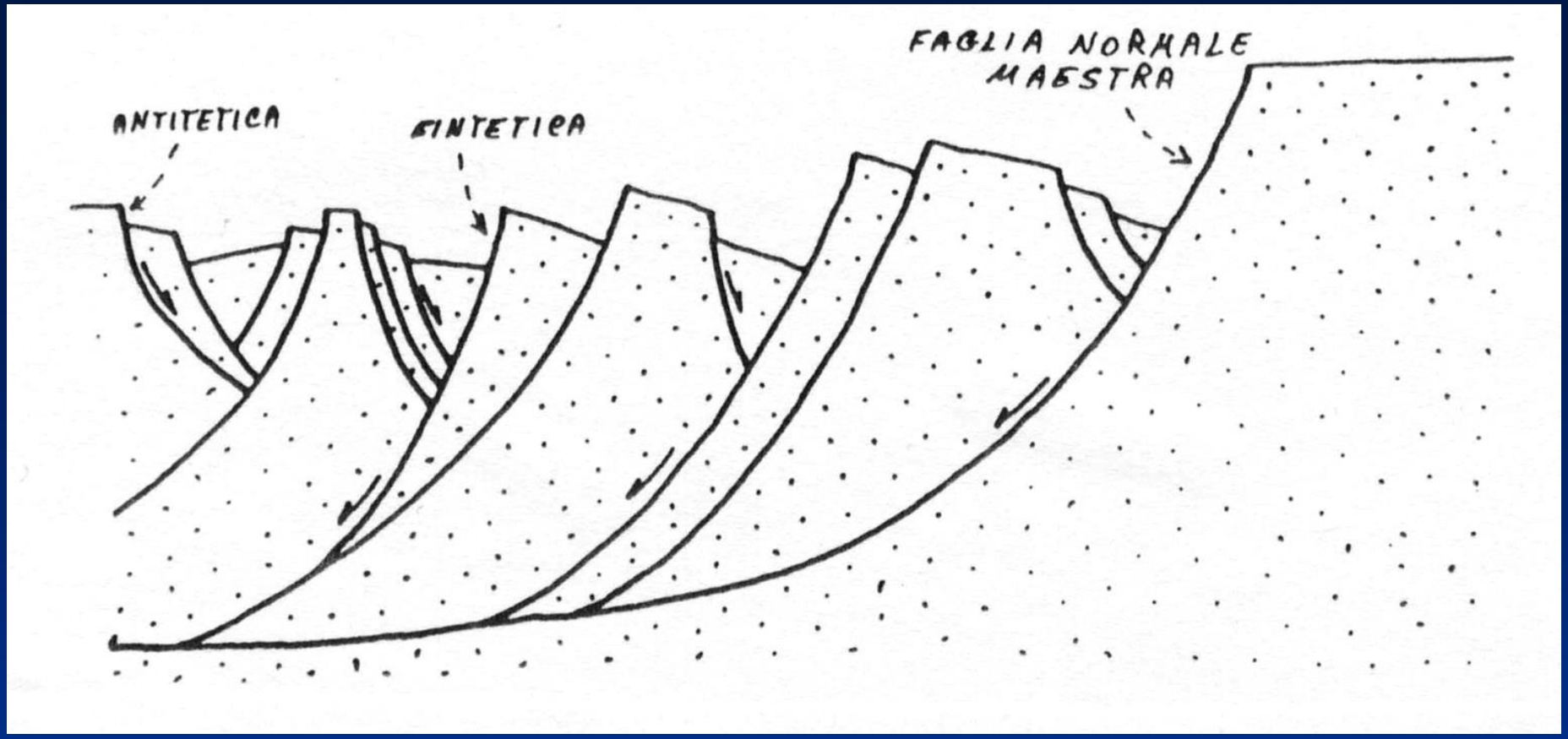
"PROFILO SISMICO"

METODO GEOGNOSTICO GEOFICO

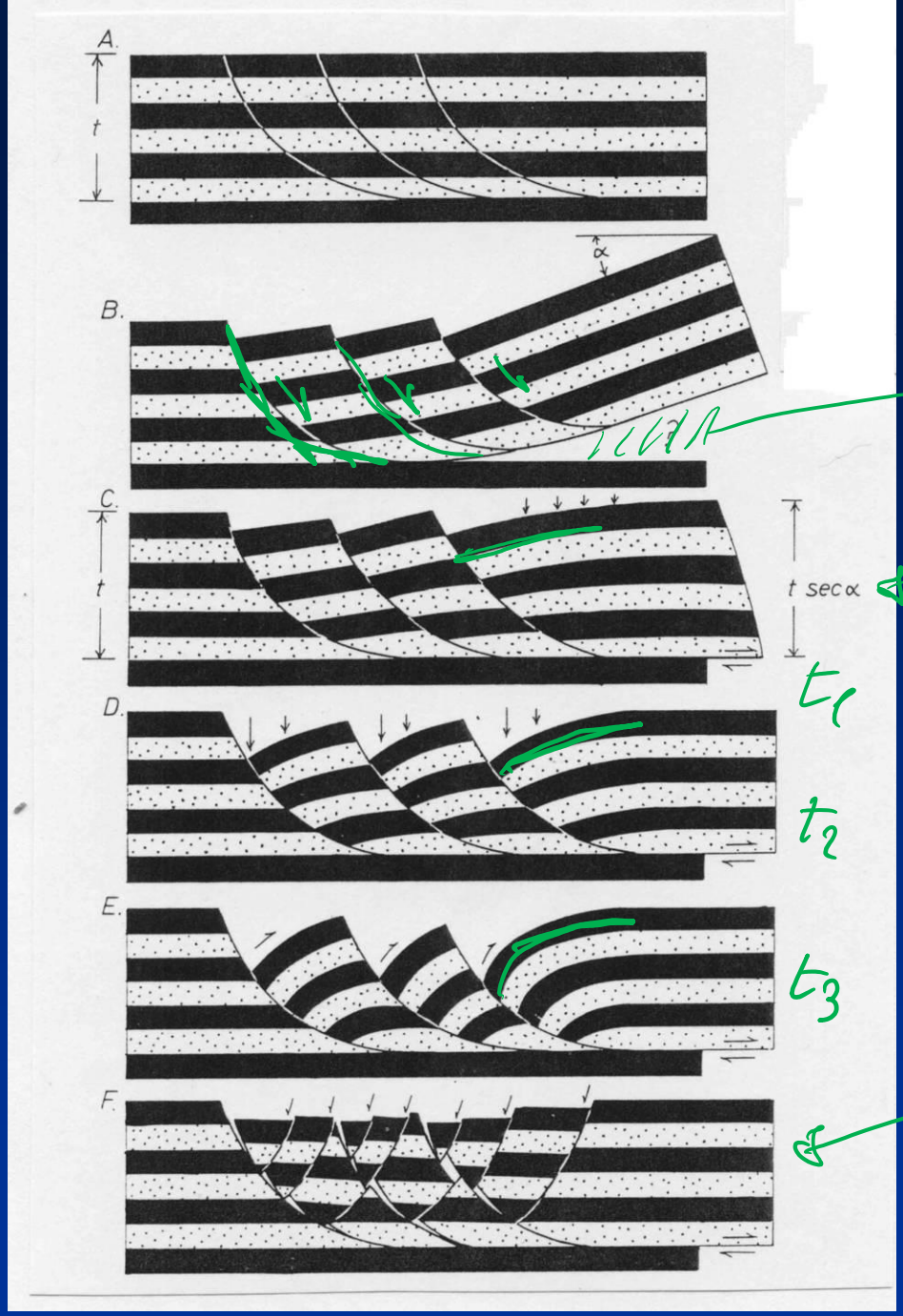




Da Hatcher, 1995



Faglia listrica

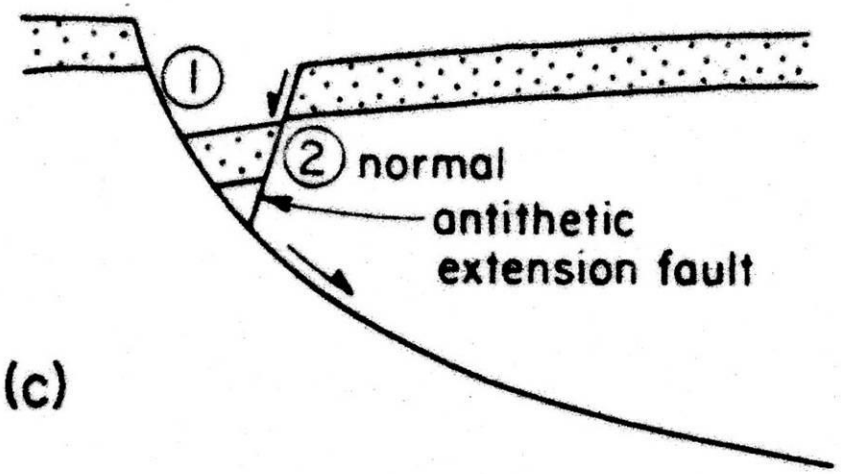


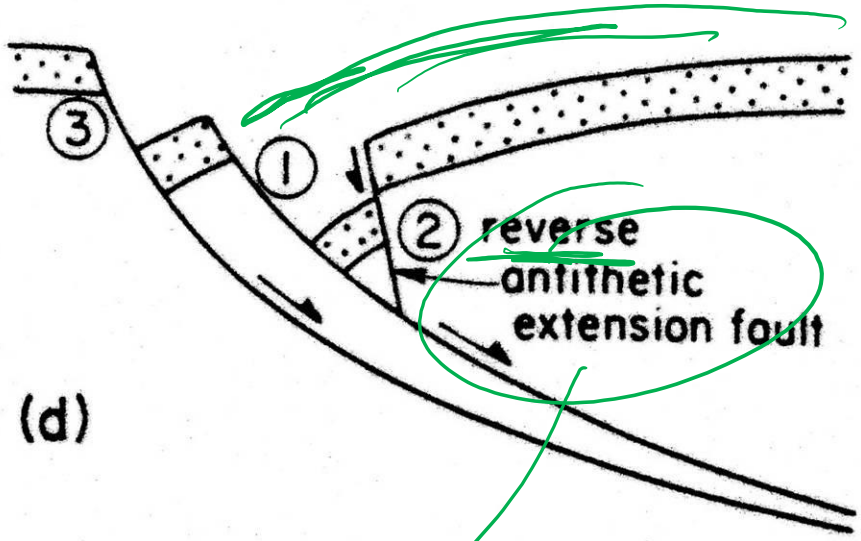
NO!!

PIEGA DEL TETTO (ROLL-OVER ANTICLINE)

SISTEMI CONIUGATI F. ANTITETICHE E SINTETICHE

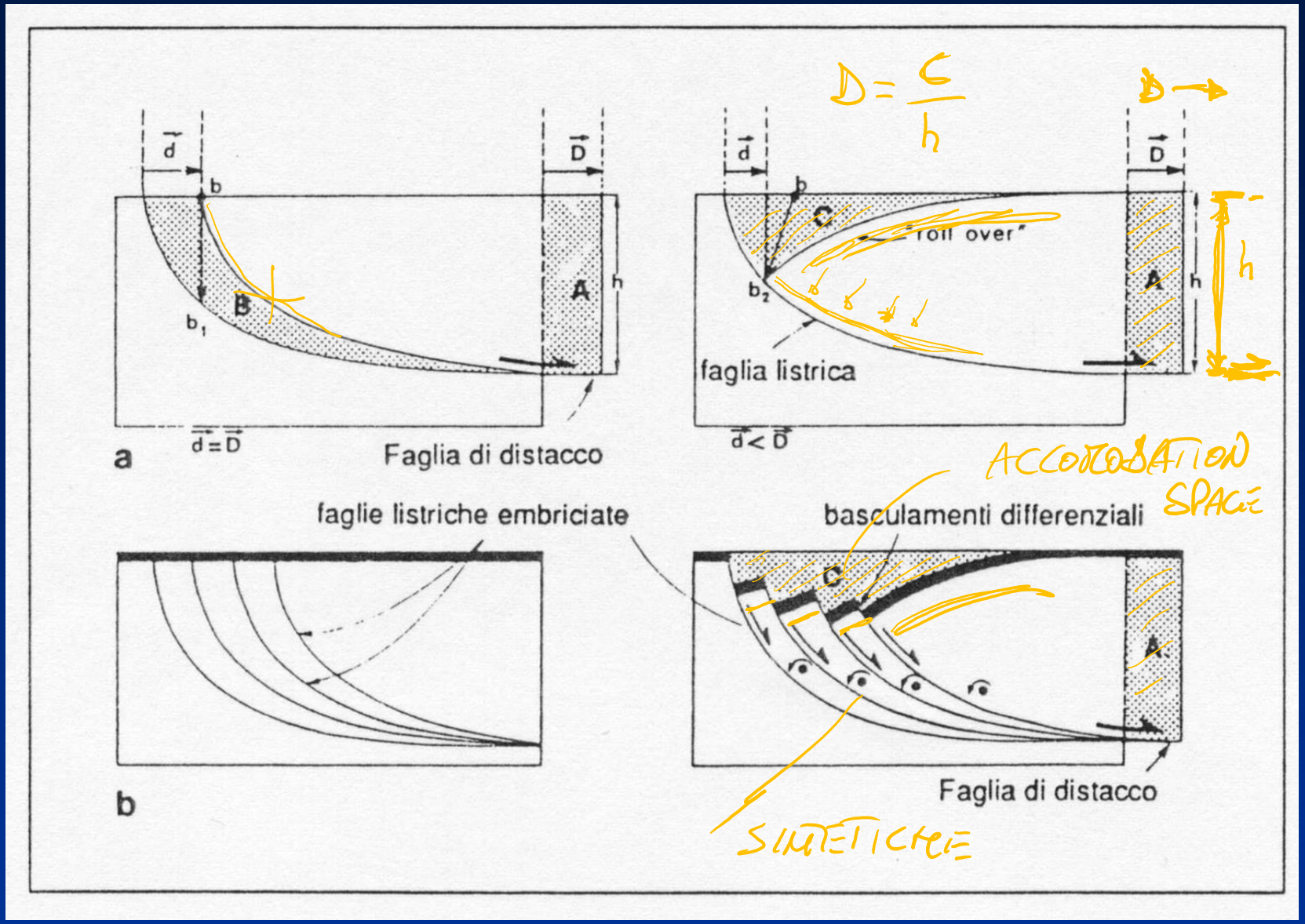
Da Ramsay and Huber, 1987



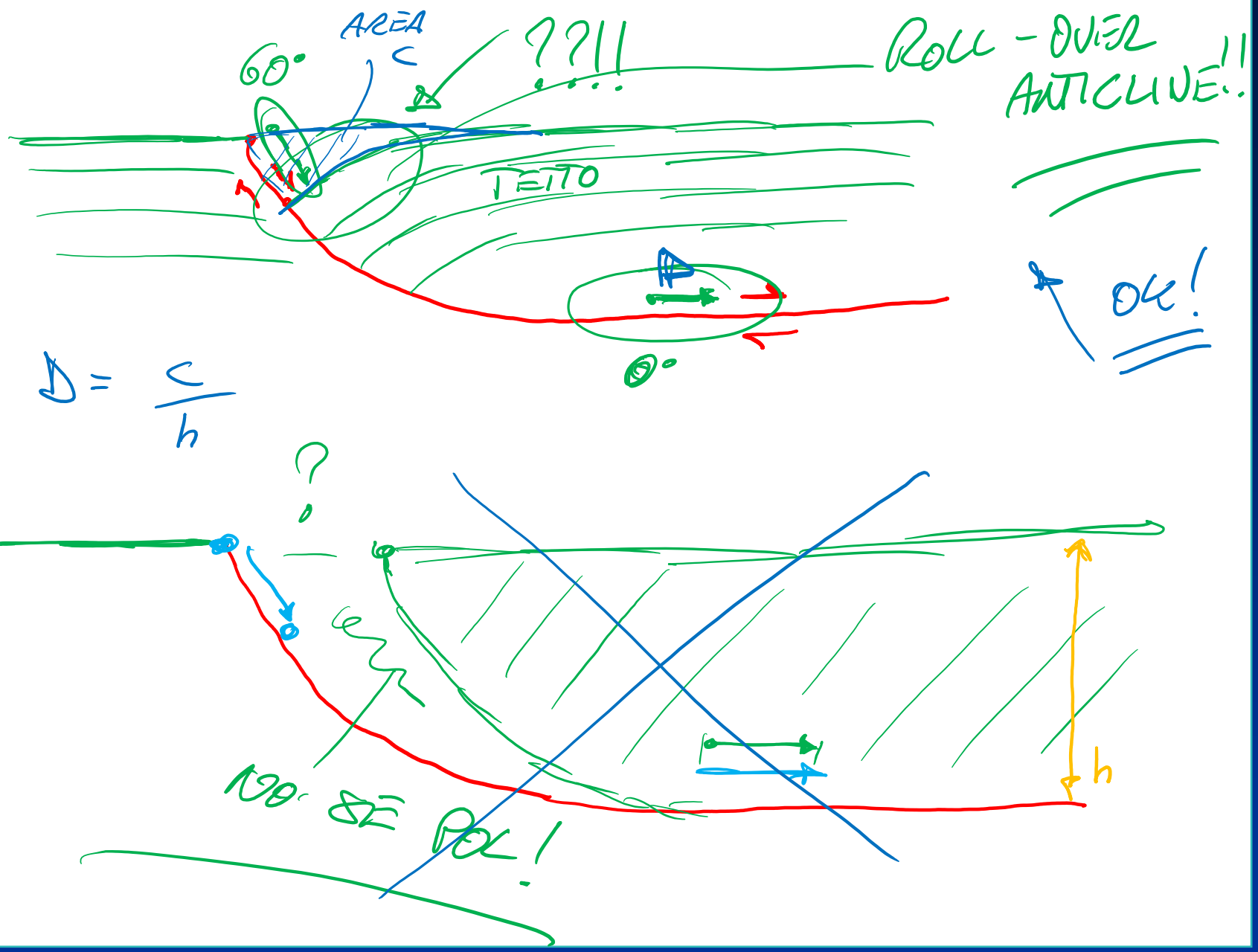


Da Hancock, 1985

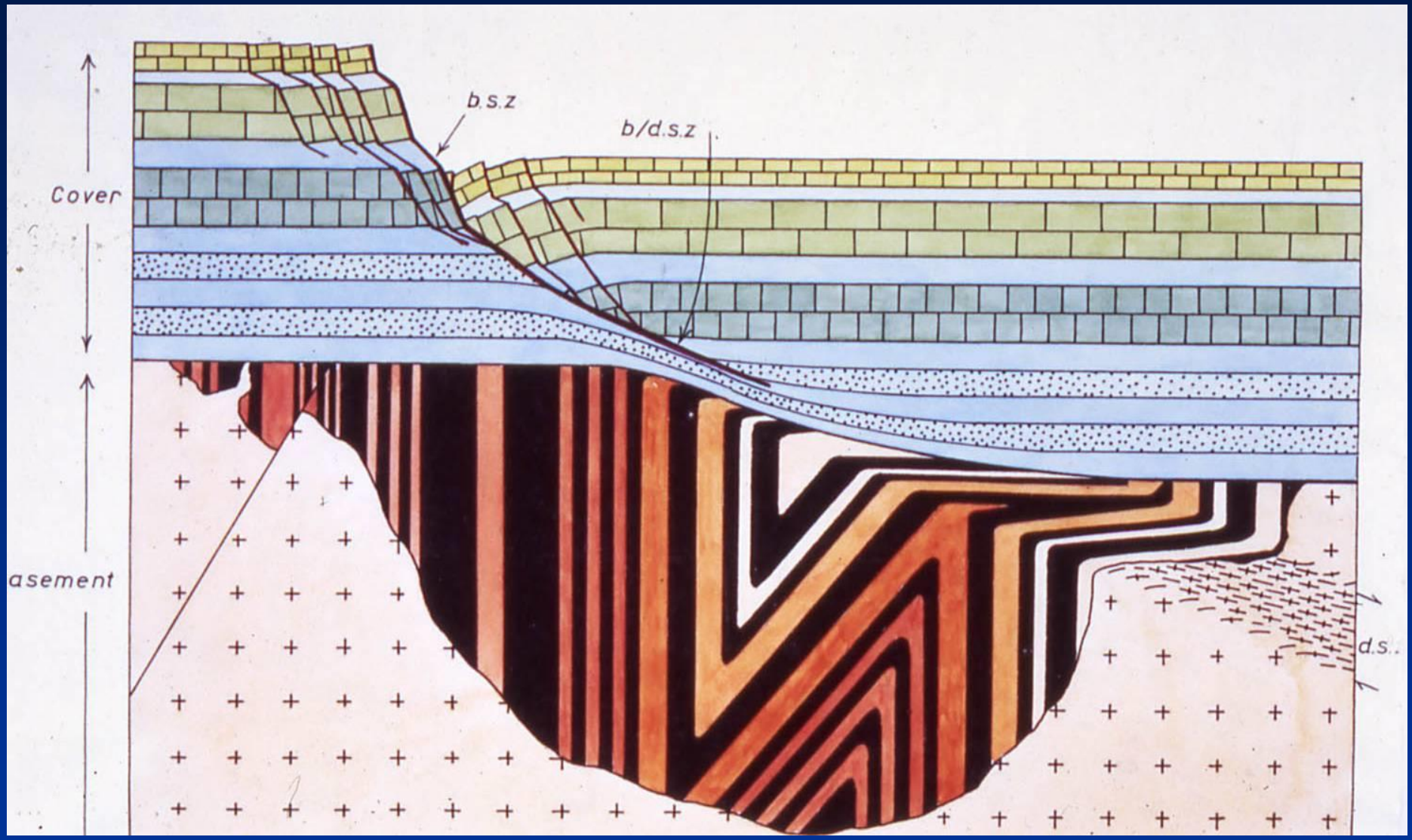
FAGLIA INVERSA



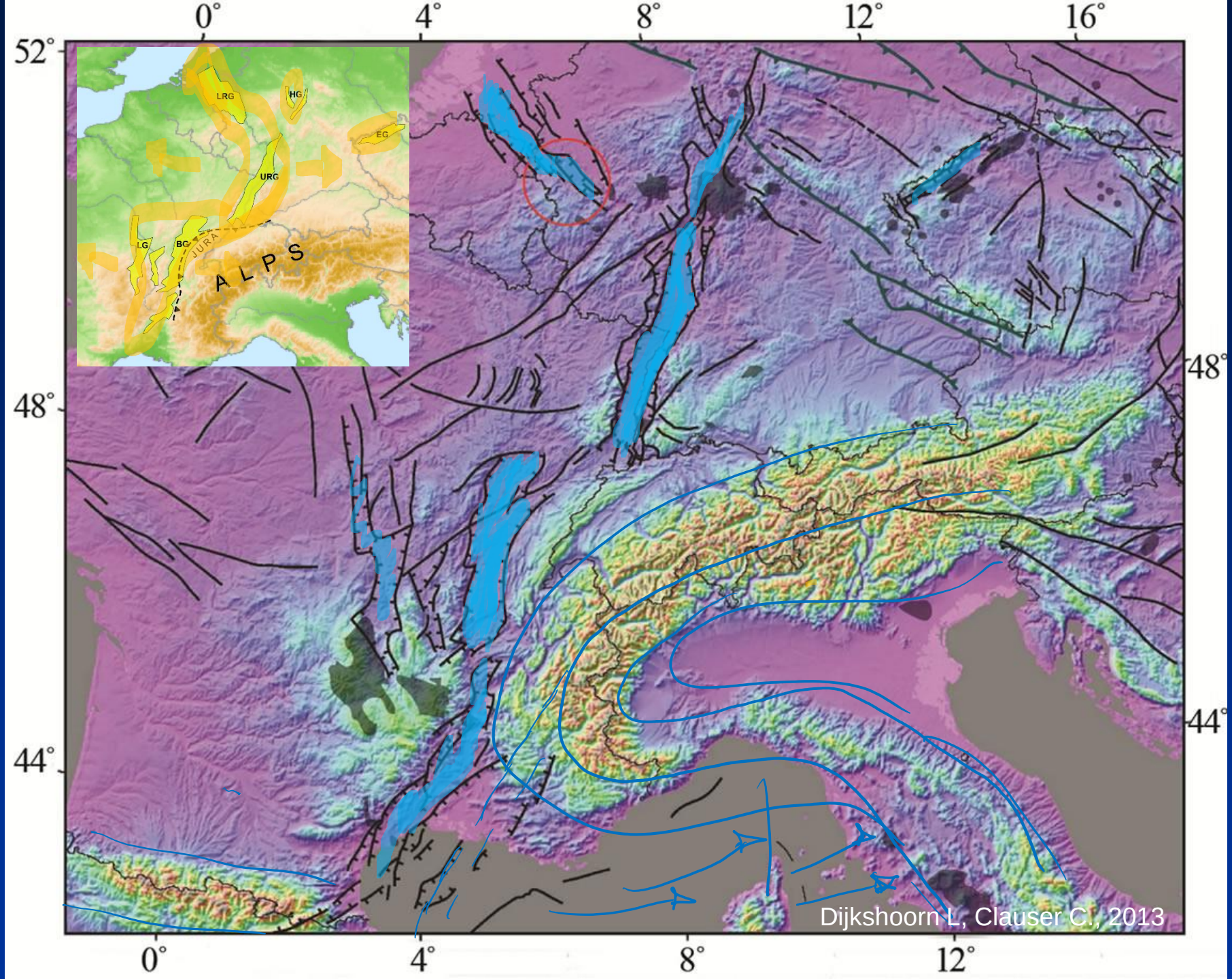
Da Mercier & Vergely, 1996

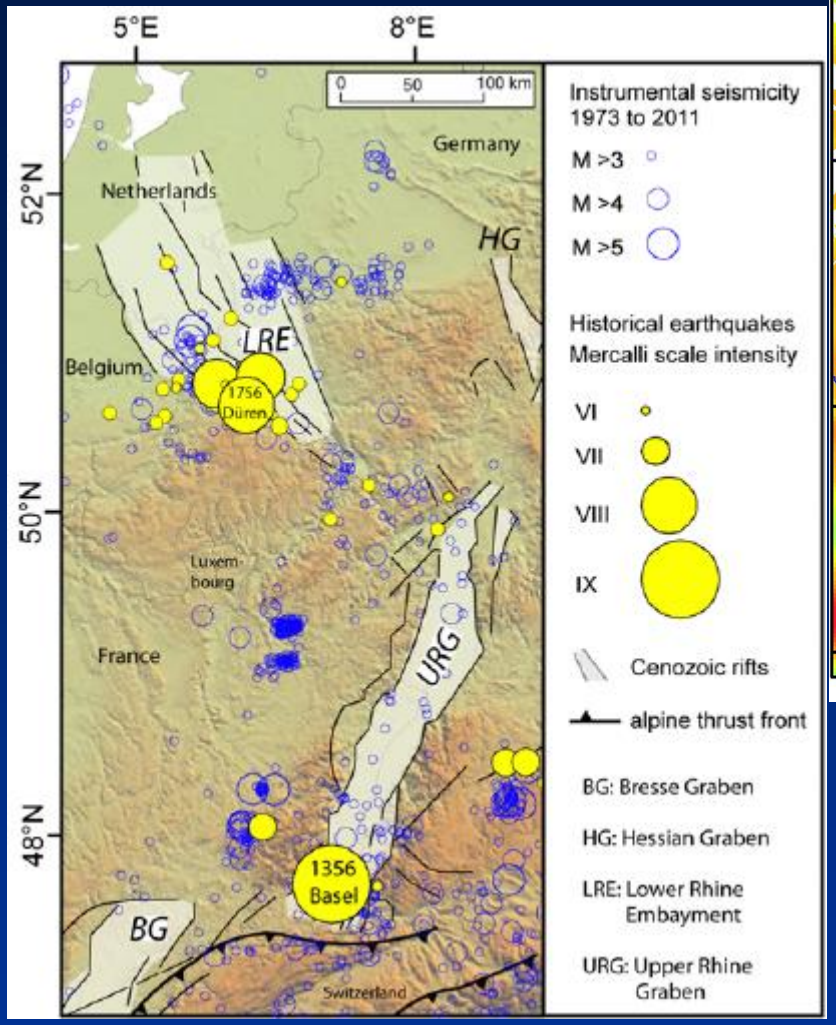

AREA
C
60°
???
ROLL-OVER
ANTICLINE!!
TETTO
OK!
D = c/h
?
h
NO DE POL!

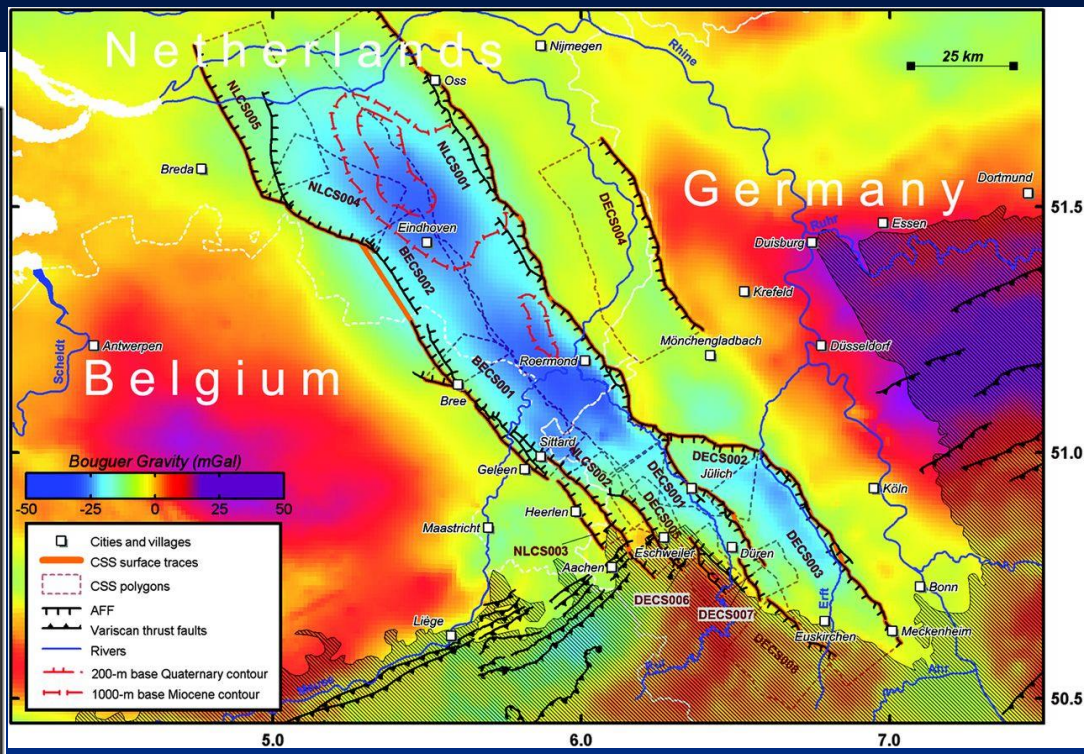
Estensione crostale

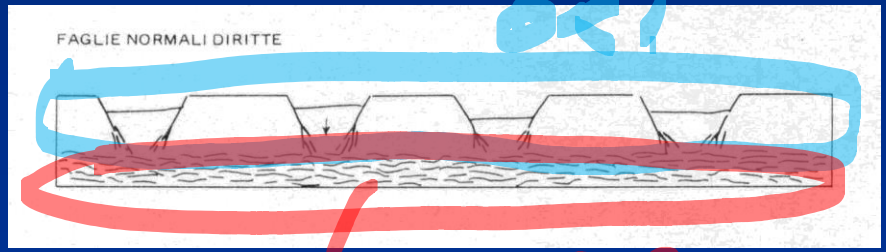


Da Ramsay and Huber, 1987

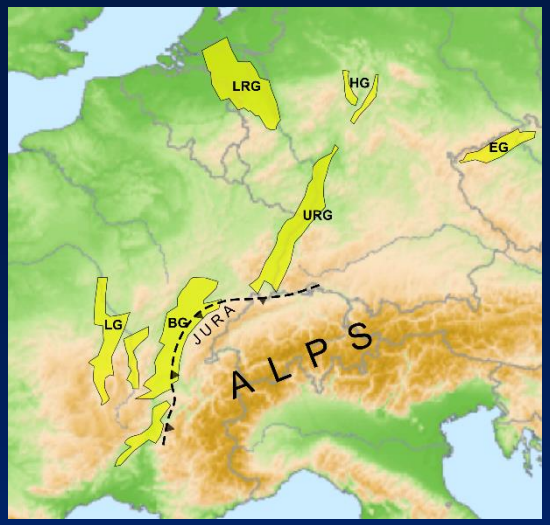

0°
4°
8°
12°
16°
52°
48°
44°
LRG
HG
EG
URG
LG
BC
JURA
ALPS
Dijkshoorn L, Clauser C., 2013

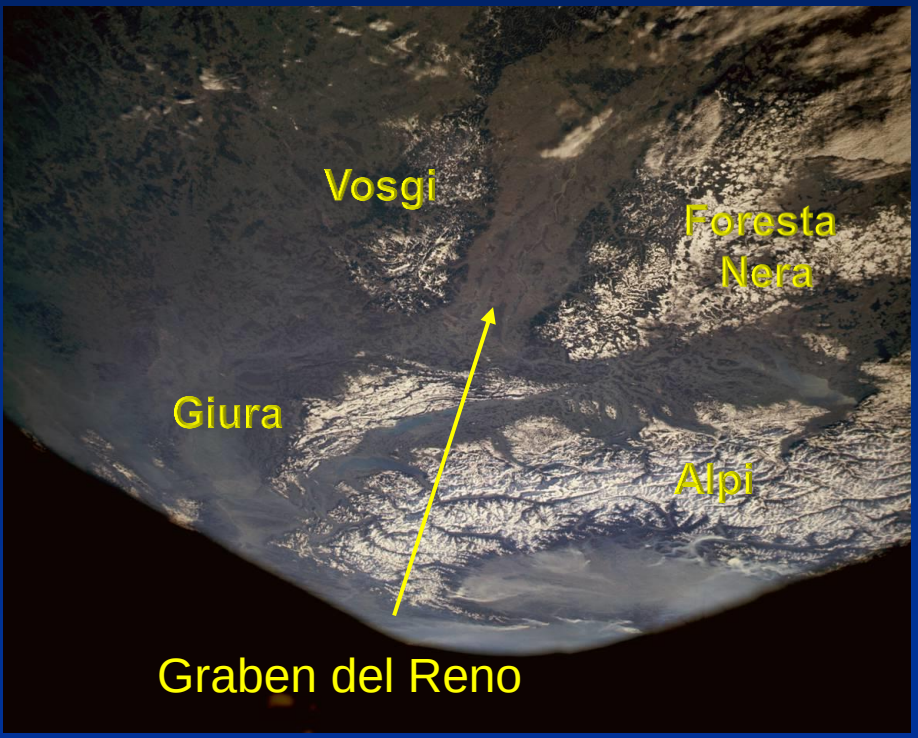

5°E
8°E
52°N
50°N
48°N
0 50 100 km
Germany
Netherlands
HG
LRE
Belgium
1756
Düren
Luxem-
bourg
France
URG
1356
Basel
BG
Switzerland
Instrumental seismicity
1973 to 2011
M >3
M >4
M >5
Historical earthquakes
Mercalli scale intensity
VI
VII
VIII
IX
Cenozoic rifts
alpine thrust front
BG: Bresse Graben
HG: Hessian Graben
LRE: Lower Rhine
Embayment
URG: Upper Rhine
Graben

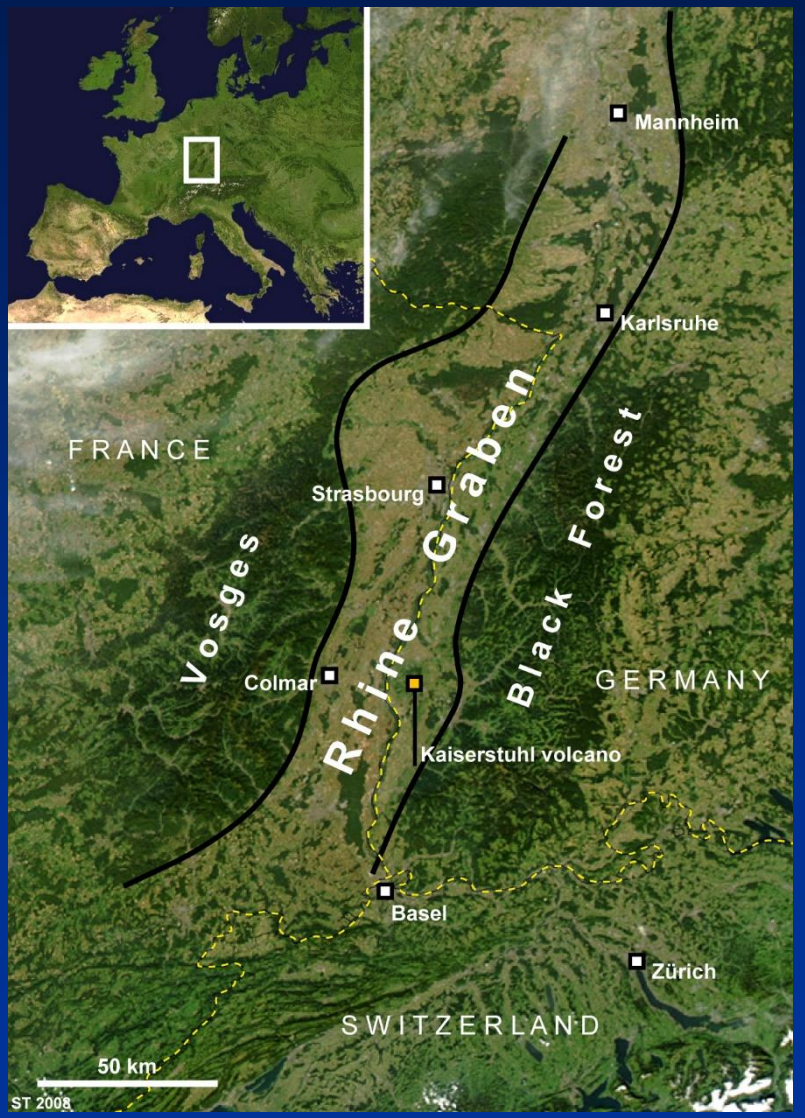

Netherlands
Germany
Belgium
Nijmegen
Rhine
25 km
Oss
Breda
Eindhoven
Dortmund
Essen
Duisburg
Ruhr
Krefeld
Mönchengladbach
Düsseldorf
Antwerpen
Scheldt
Roermond
Bree
Sittard
Geleen
Jülich
Köln
Heerlen
Maastricht
Eschweiler
Aachen
Düren
Bonn
Liège
Euskirchen
Meckenheim
Erft
Ahr
NLCS005
NLCS004
NLCS001
NLCS002
NLCS003
DECS004
DECS002
DECS001
DECS005
DECS006
DECS007
DECS003
BECS002
BECS001
Bouguer Gravity (mGal)
-50 -25 0 25 50
Cities and villages
CSS surface traces
CSS polygons
AFF
Variscan thrust faults
Rivers
200-m base Quaternary contour
1000-m base Miocene contour
51.5
51.0
50.5
5.0
6.0
7.0

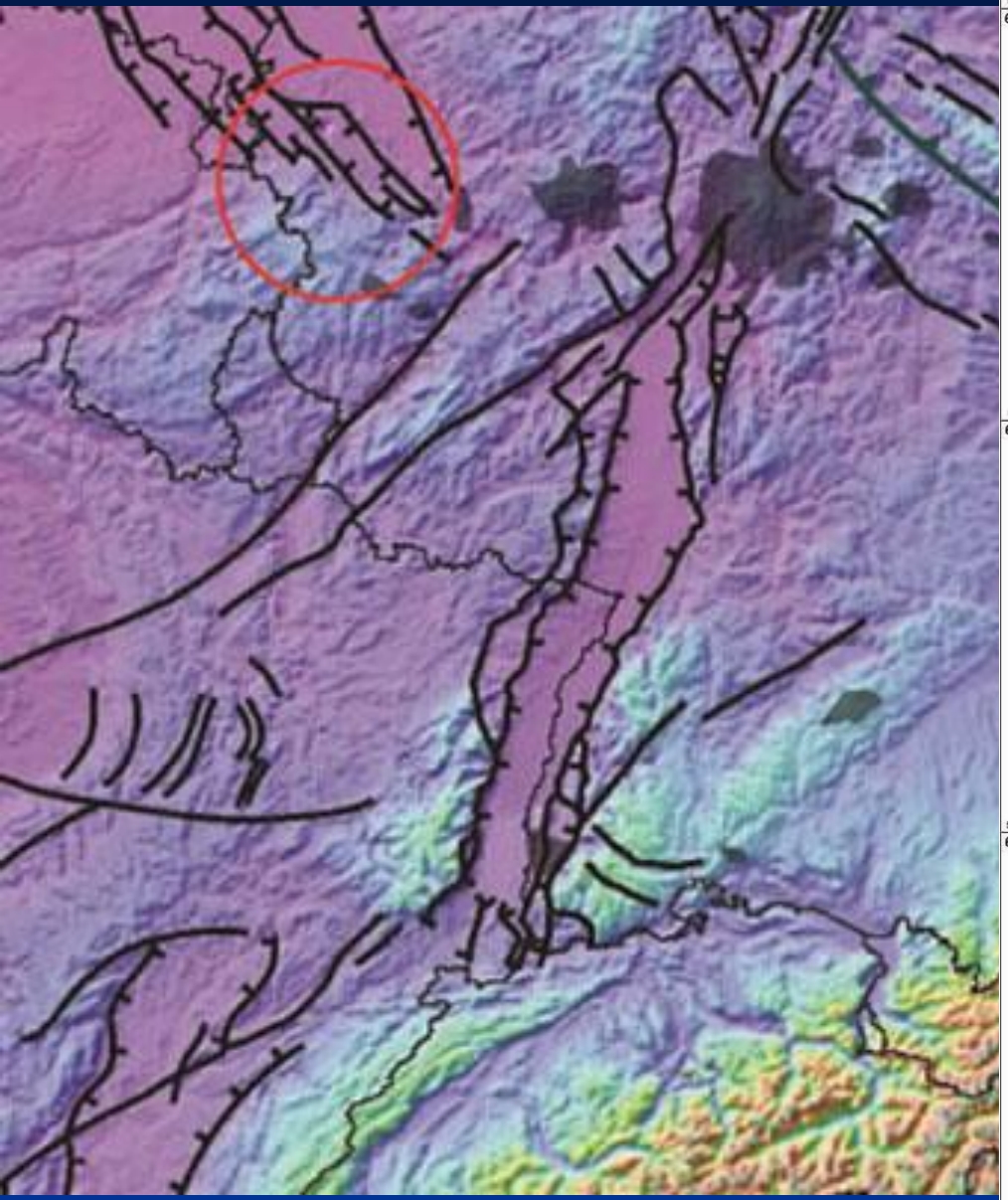

FAGLIE NORMALI DIRITTE

Graben del Reno

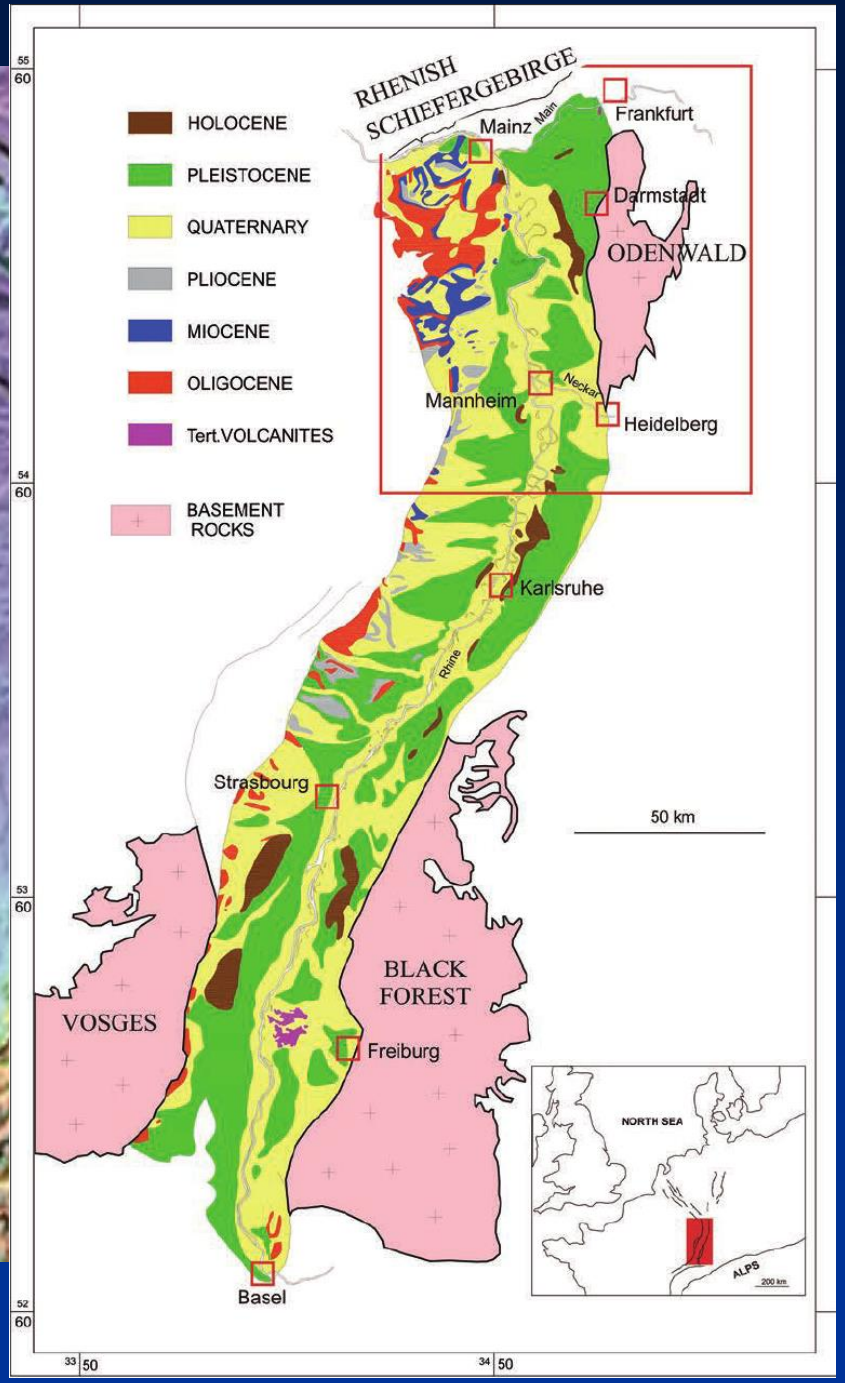








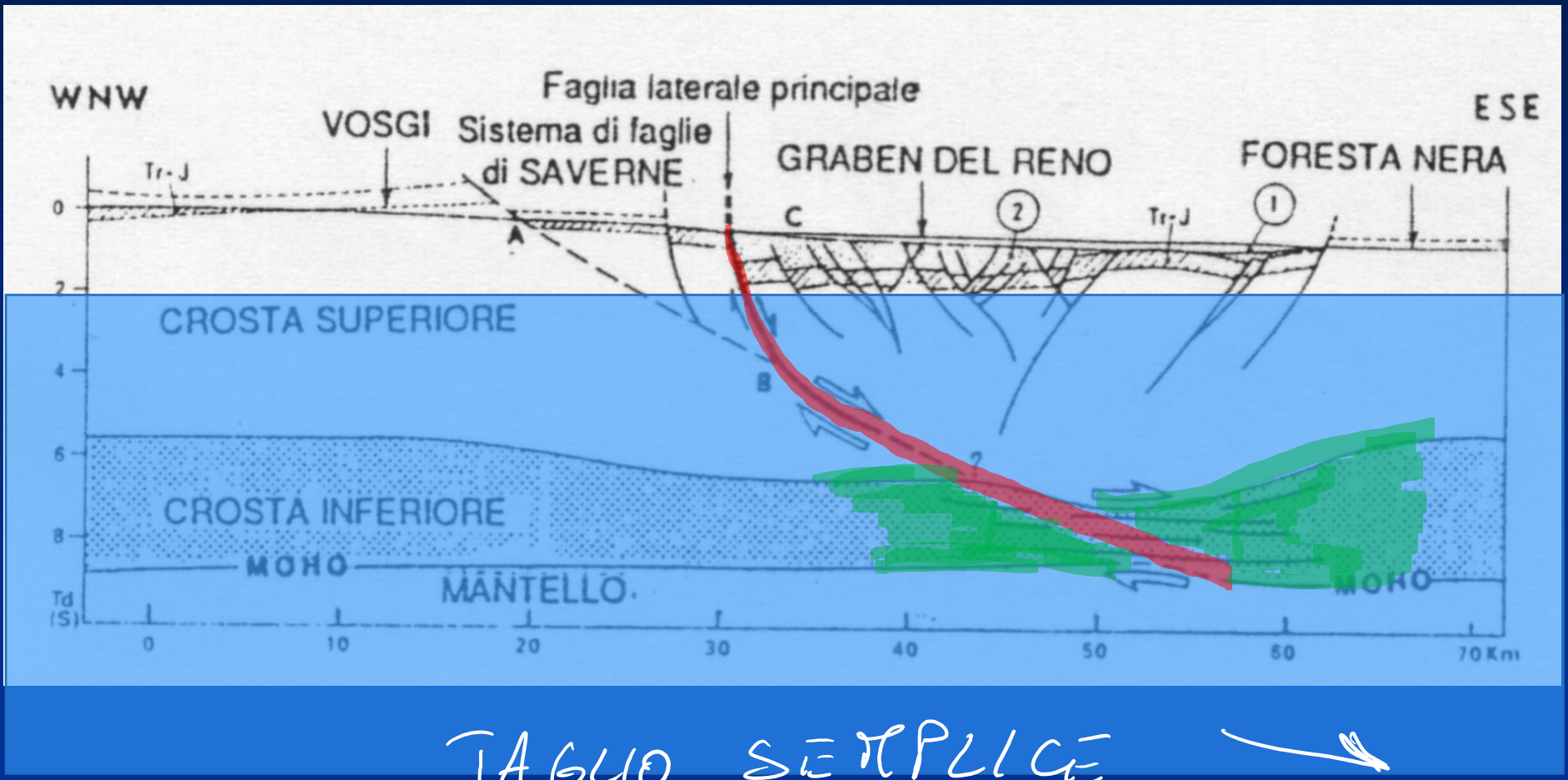
Da Dijkshoorn & Clauser, 2013



Przyrowski & Schäfer, 2015

Da Mercier & Vergely, 1996

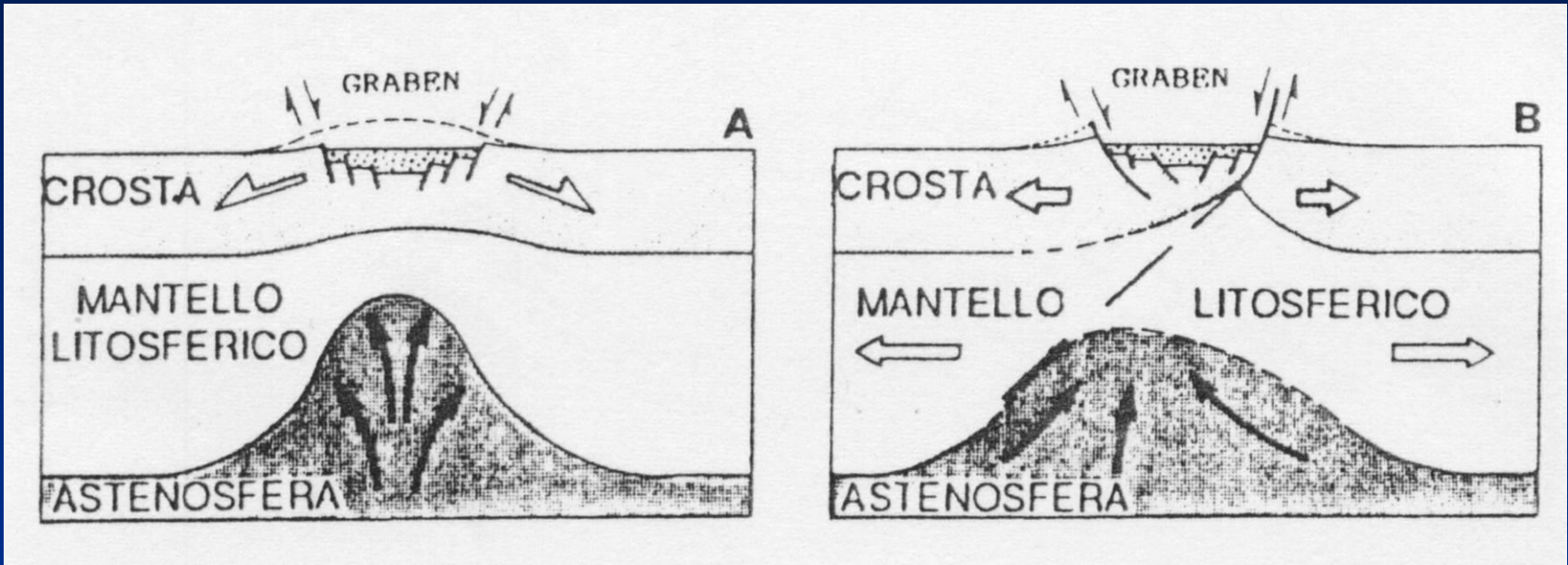
TAGLIO PURO? NO!



TAGLIO SEMPLICE

T. RIFT

T. SEMPLICE



Da Mercier & Vergely, 1996

SIMMETRICO
ANCHE
IN PROF.

S. ASIMMETRICO

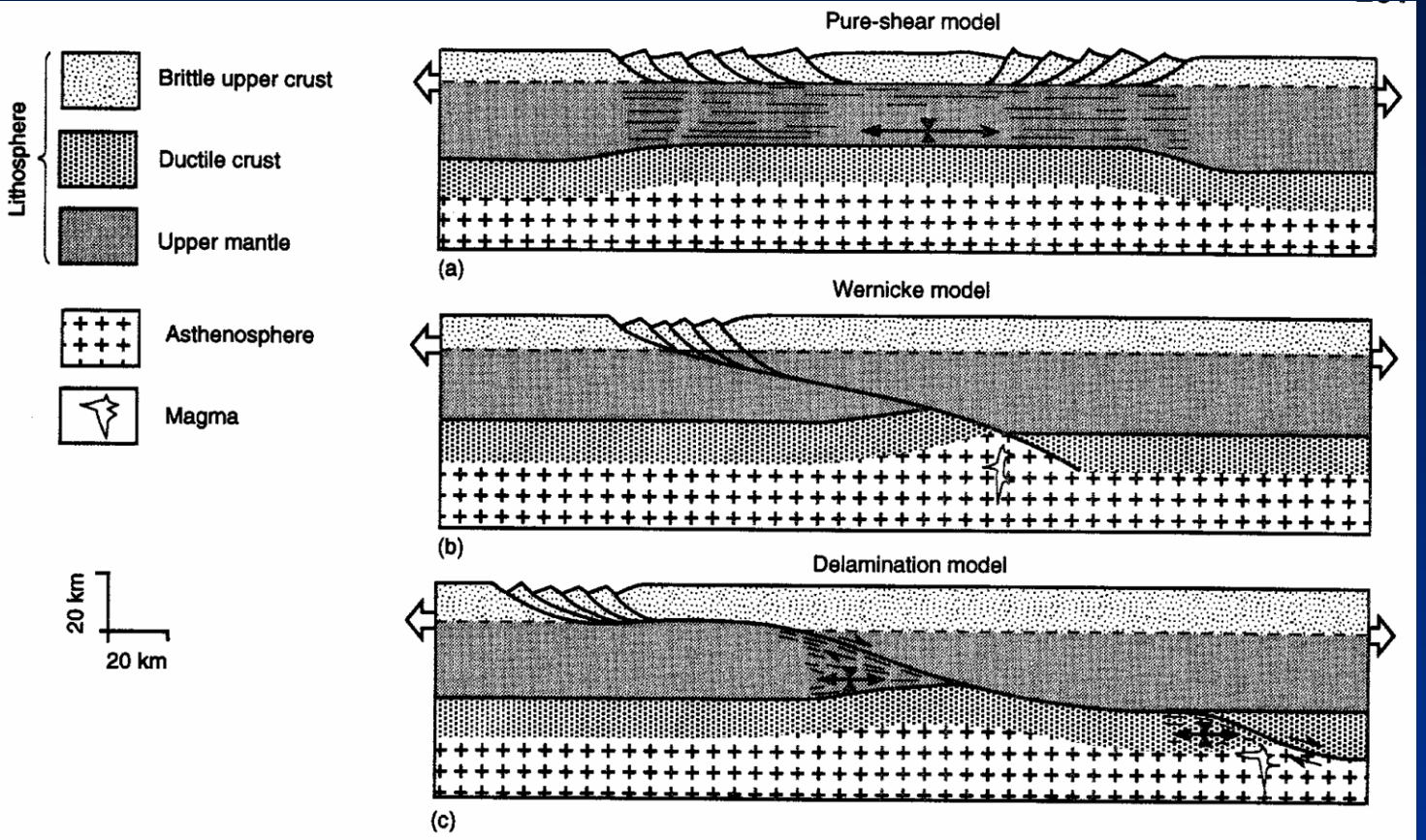
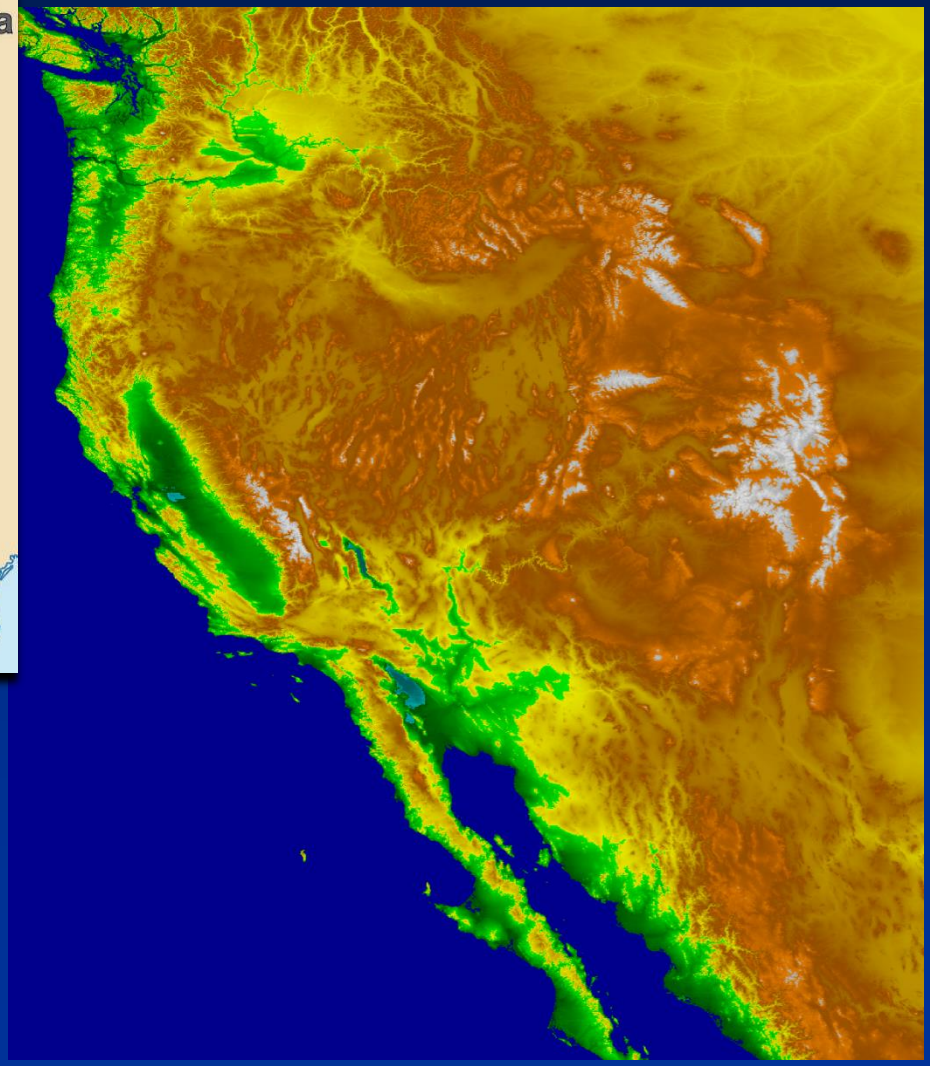


FIGURE 13–15
Three models of extension of continental crust. (a) McKenzie "pure-shear" model: symmetrical rifting and pure shear. b) Wernicke model: asymmetric rifting with simple shear. (c) Delamination model: asymmetric rifting with simple shear and delamination. (From G. S. Lister, M. A. Etheridge, and P. A. Symonds, *Geology,* v. 14, 1986.)

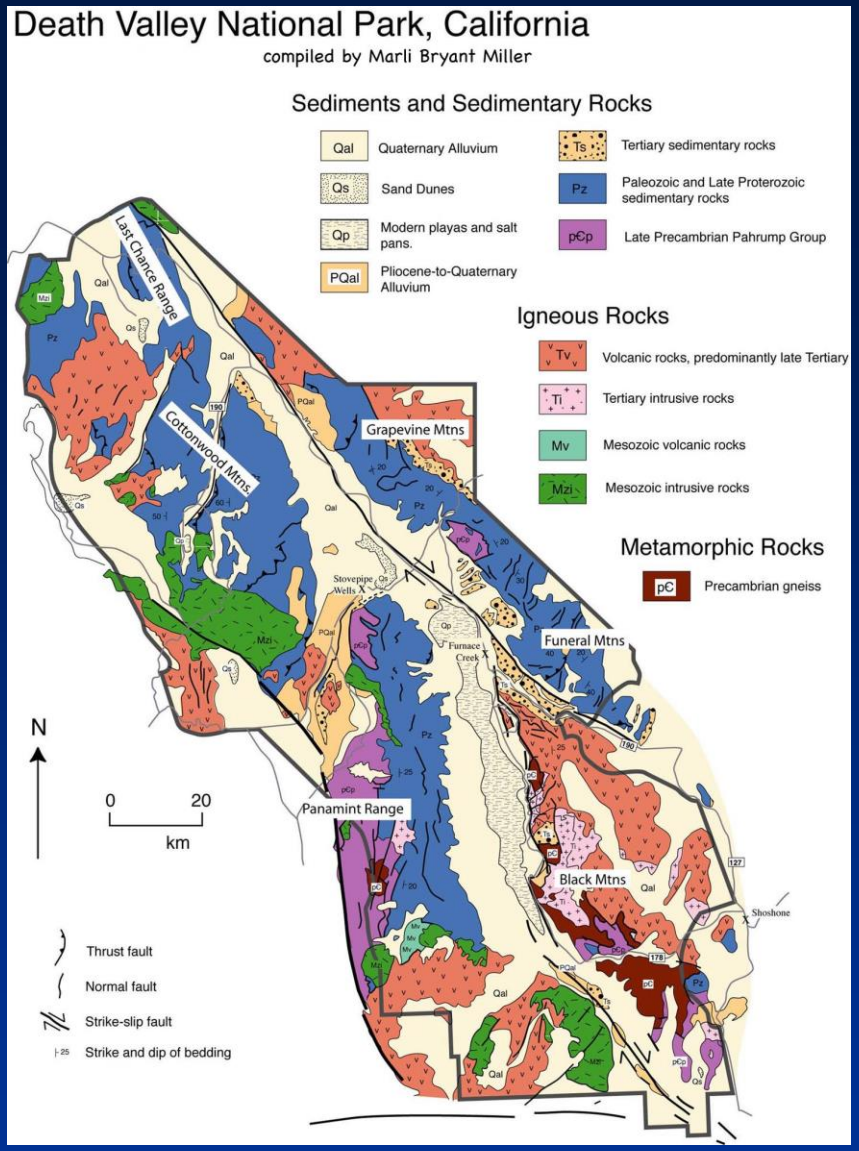
T. PURO

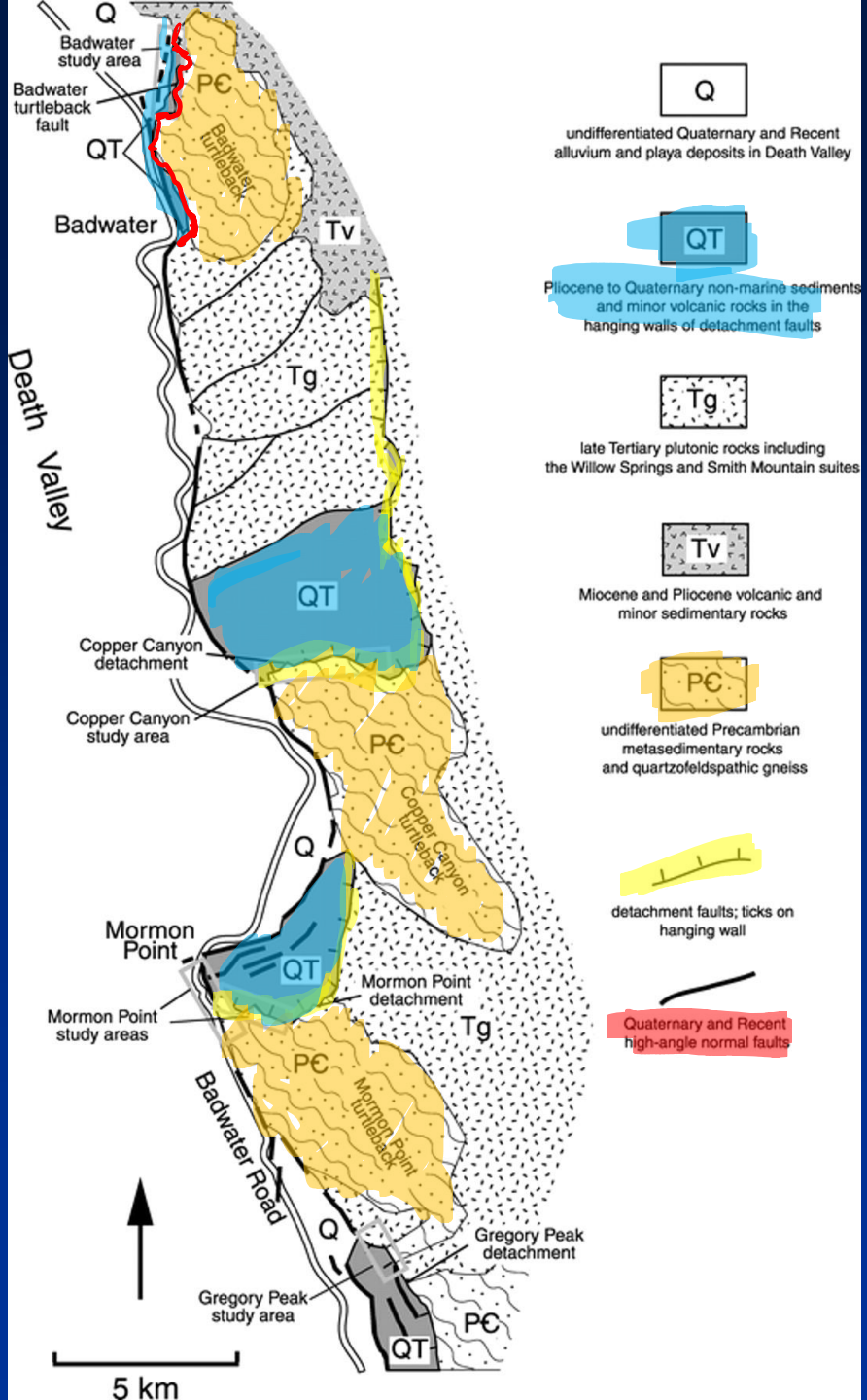
T. SEMPLICE

Da Hatcher , 1995

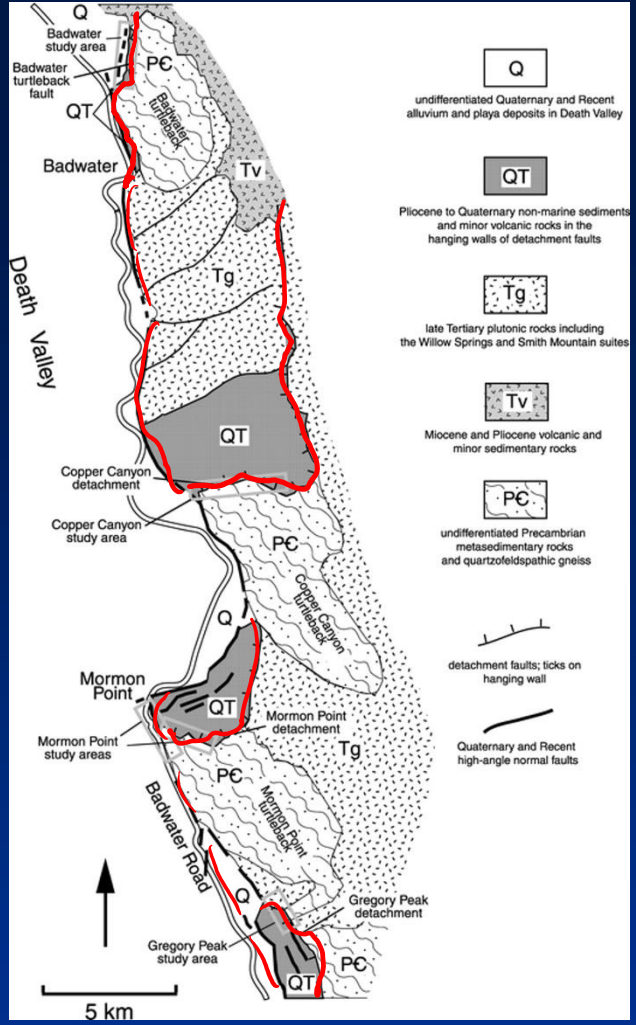


Basin & Range, estensione intra-continentale

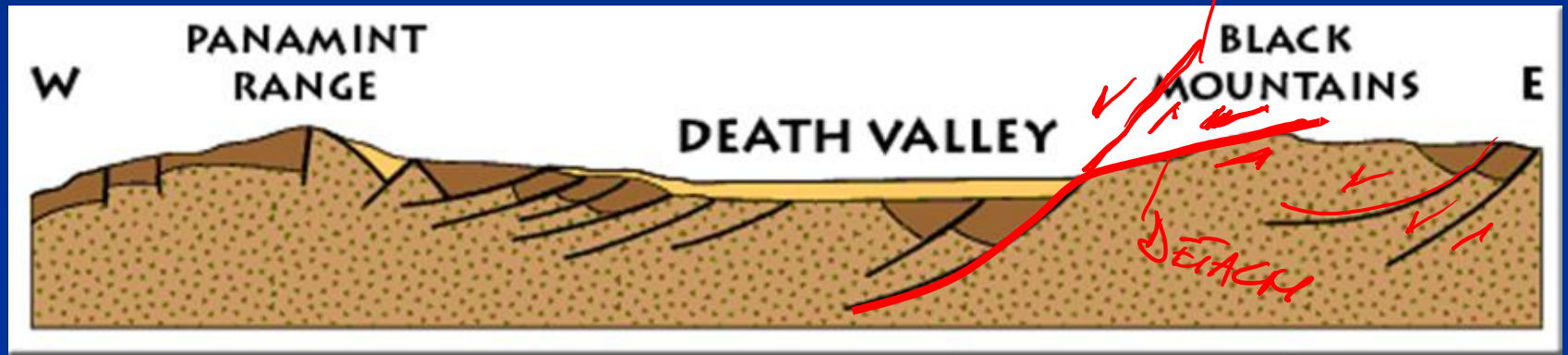


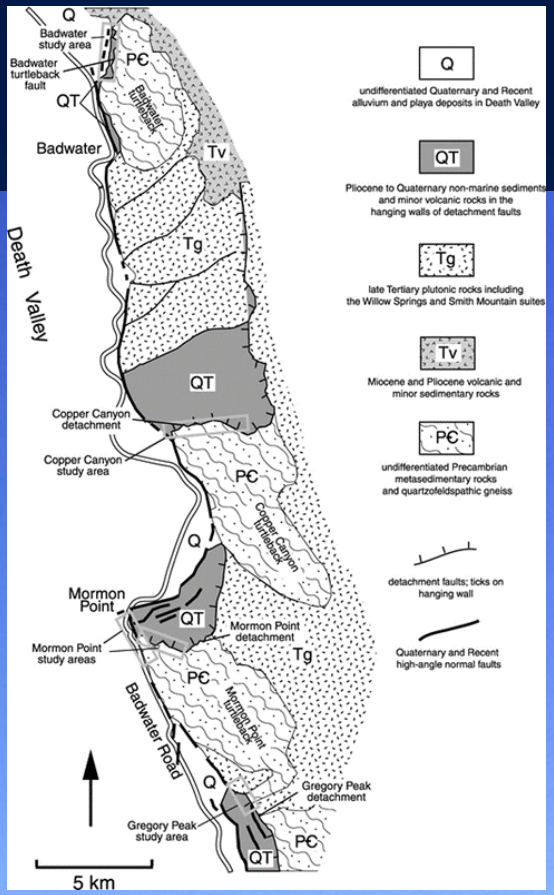


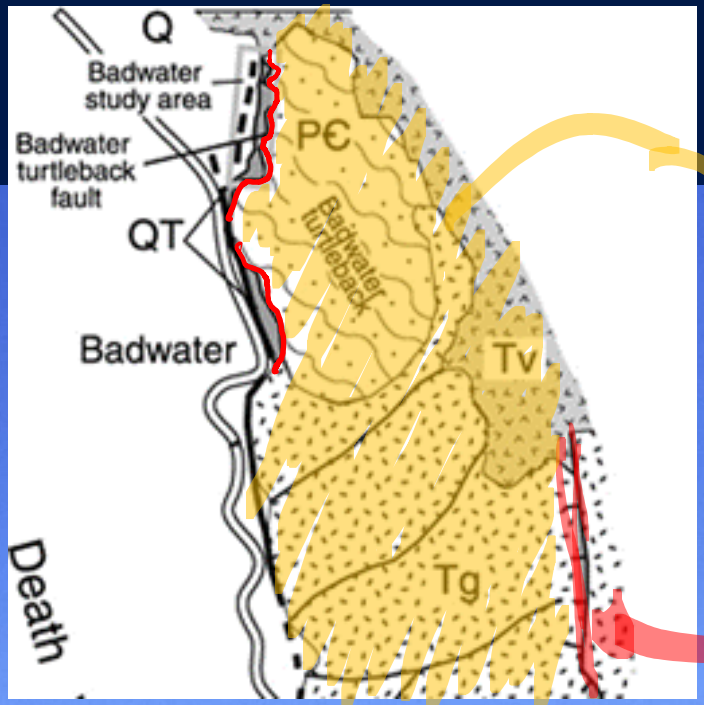
Valle della morte (Basin & Range)



F. NORCADE + GIOVANI





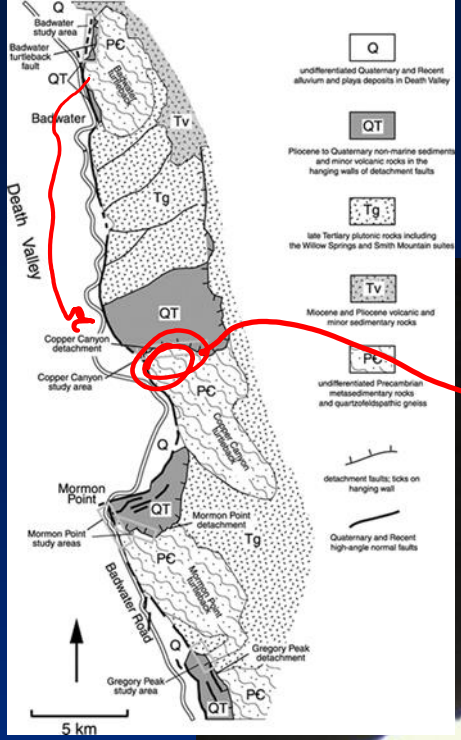


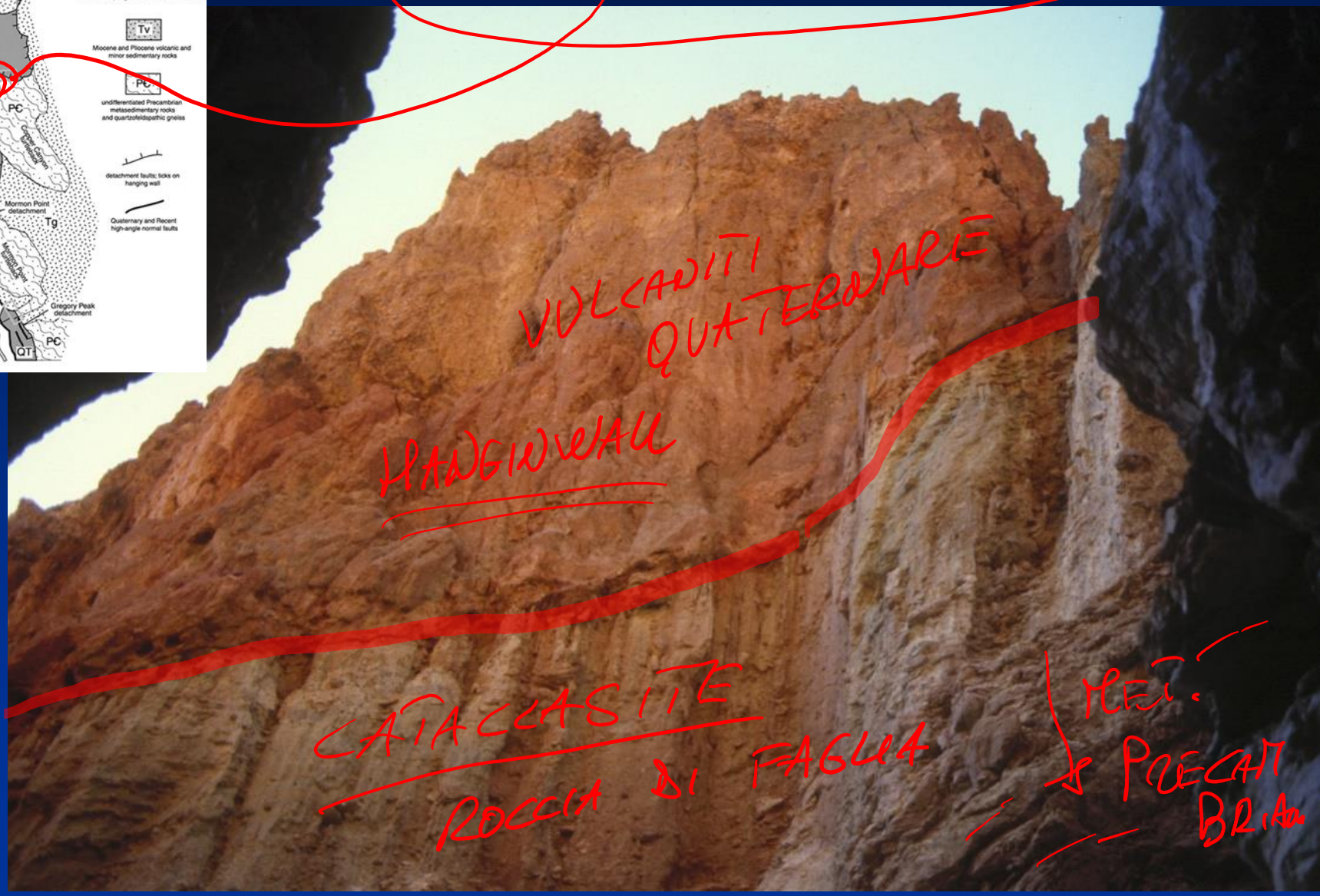
Badwater Turtleback normal fault

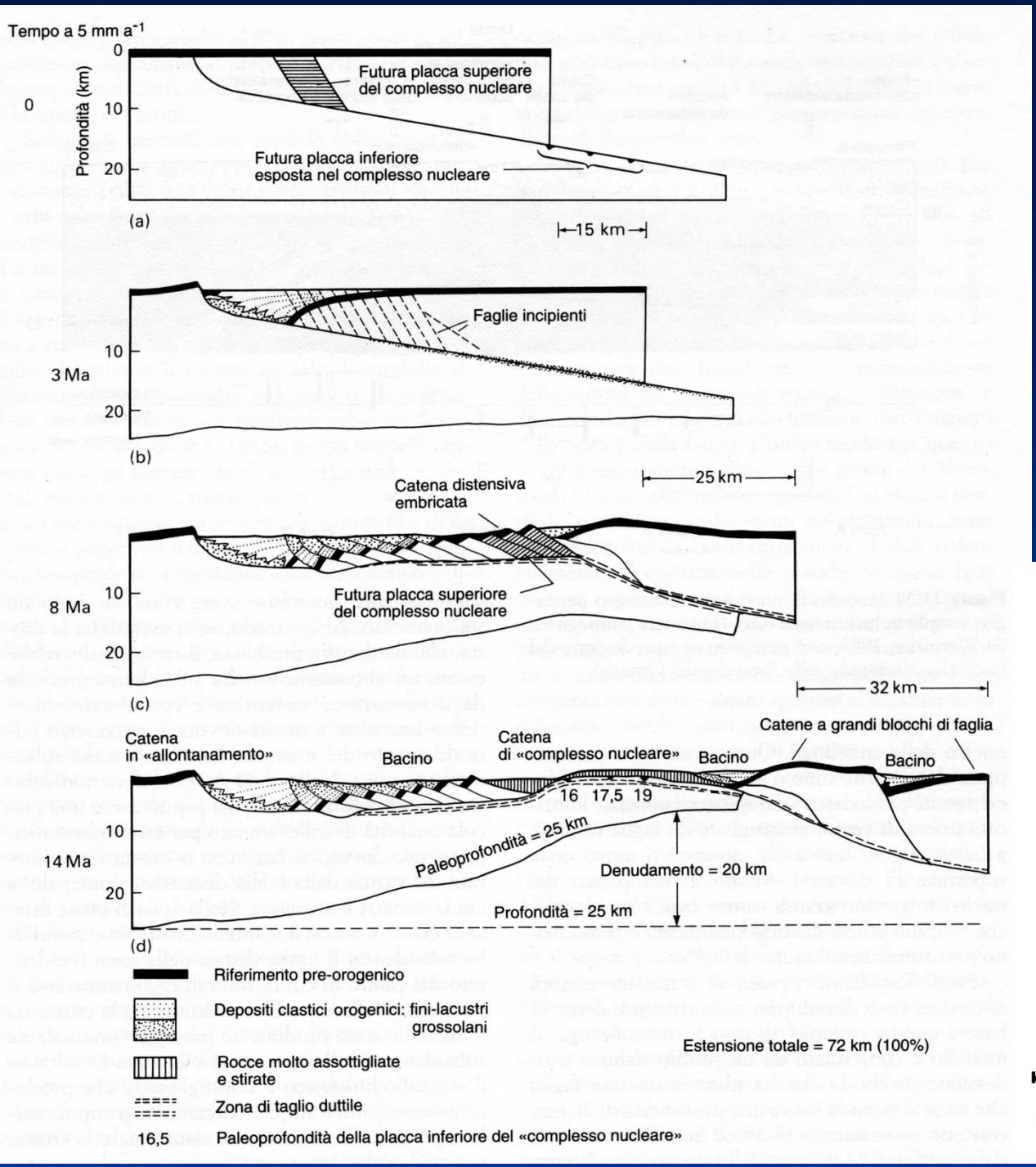
DETACHMENT

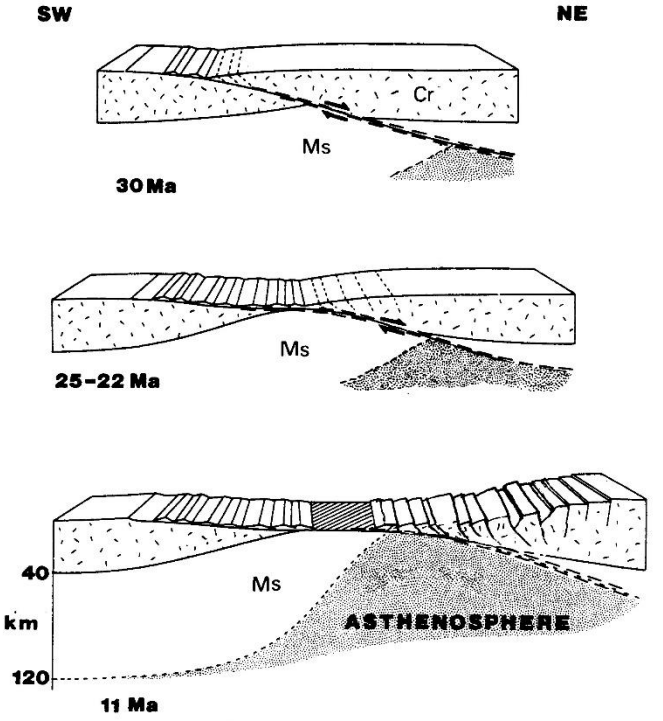
~~Badwater Turtleback~~ normal fault:

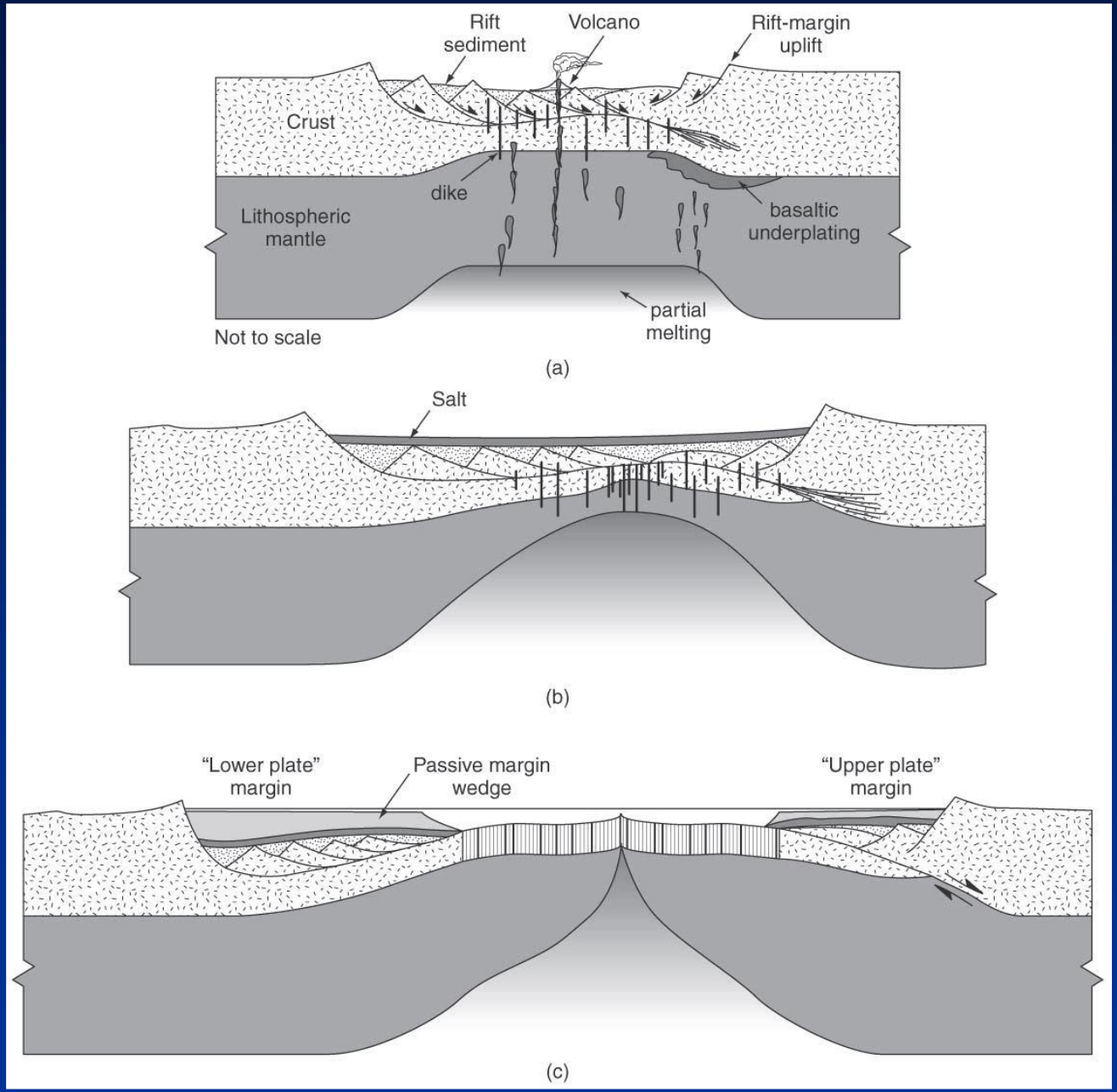
Copper Canyon fault zone



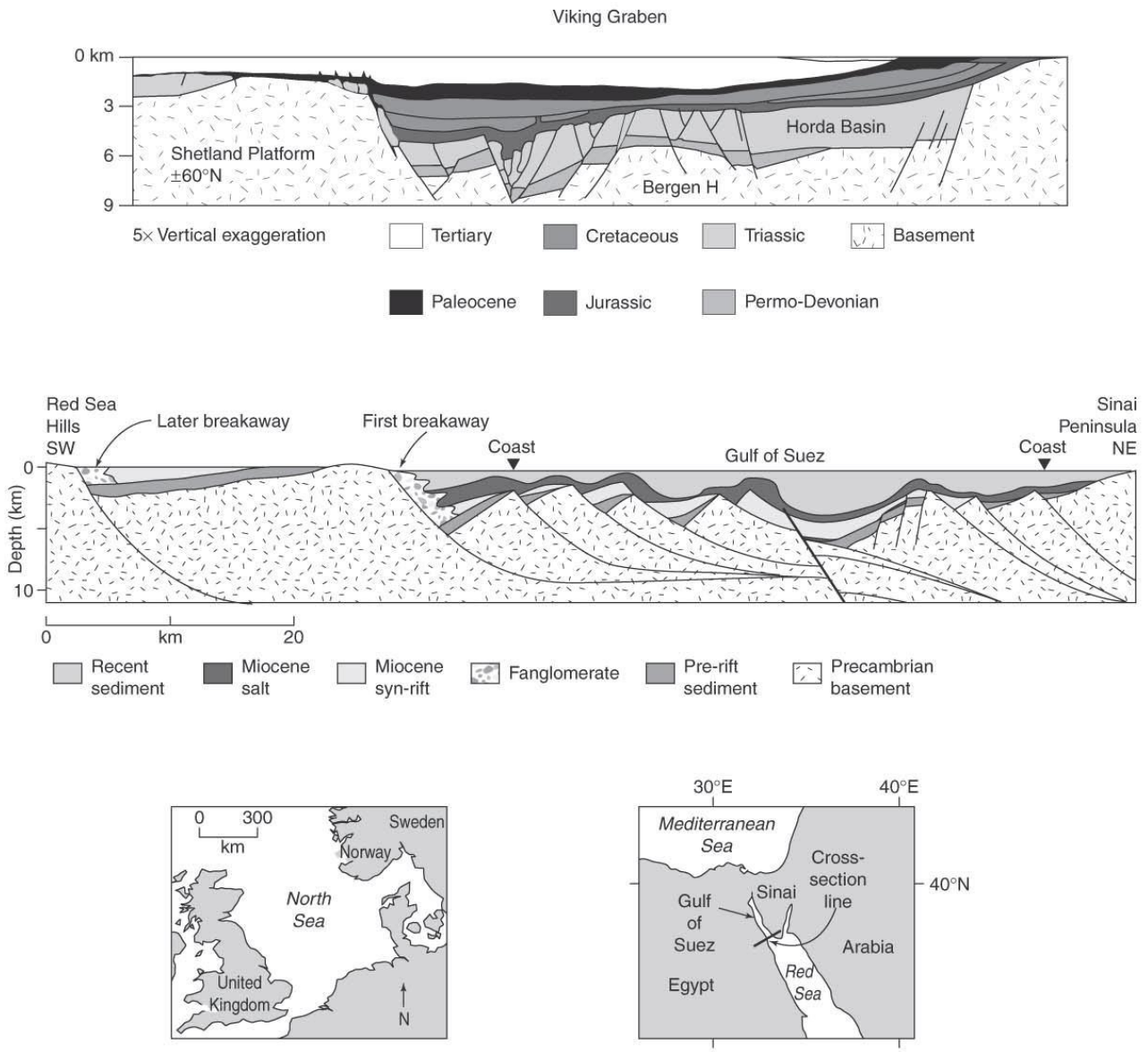



Tempo a 5 mm a-1
0
Profondità (km)
10
20
Futura placca superiore del complesso nucleare
Futura placca inferiore esposta nel complesso nucleare
(a)
15 km
3 Ma
Faglie incipienti
(b)
25 km
Catena distensiva embricata
8 Ma
Futura placca superiore del complesso nucleare
(c)
32 km
Catena in «allontanamento»
Bacino
Catena di «complesso nucleare»
Bacino
Catene a grandi blocchi di faglia
Bacino
16 17,5 19
14 Ma
Paleoprofondità = 25 km
Denudamento = 20 km
Profondità = 25 km
(d)
Riferimento pre-orogenico
Depositi clastici orogenici: fini-lacustri grossolani
Rocce molto assottigliate e stirate
Zona di taglio duttile
16,5
Paleoprofondità della placca inferiore del «complesso nucleare»
Estensione totale = 72 km (100%)

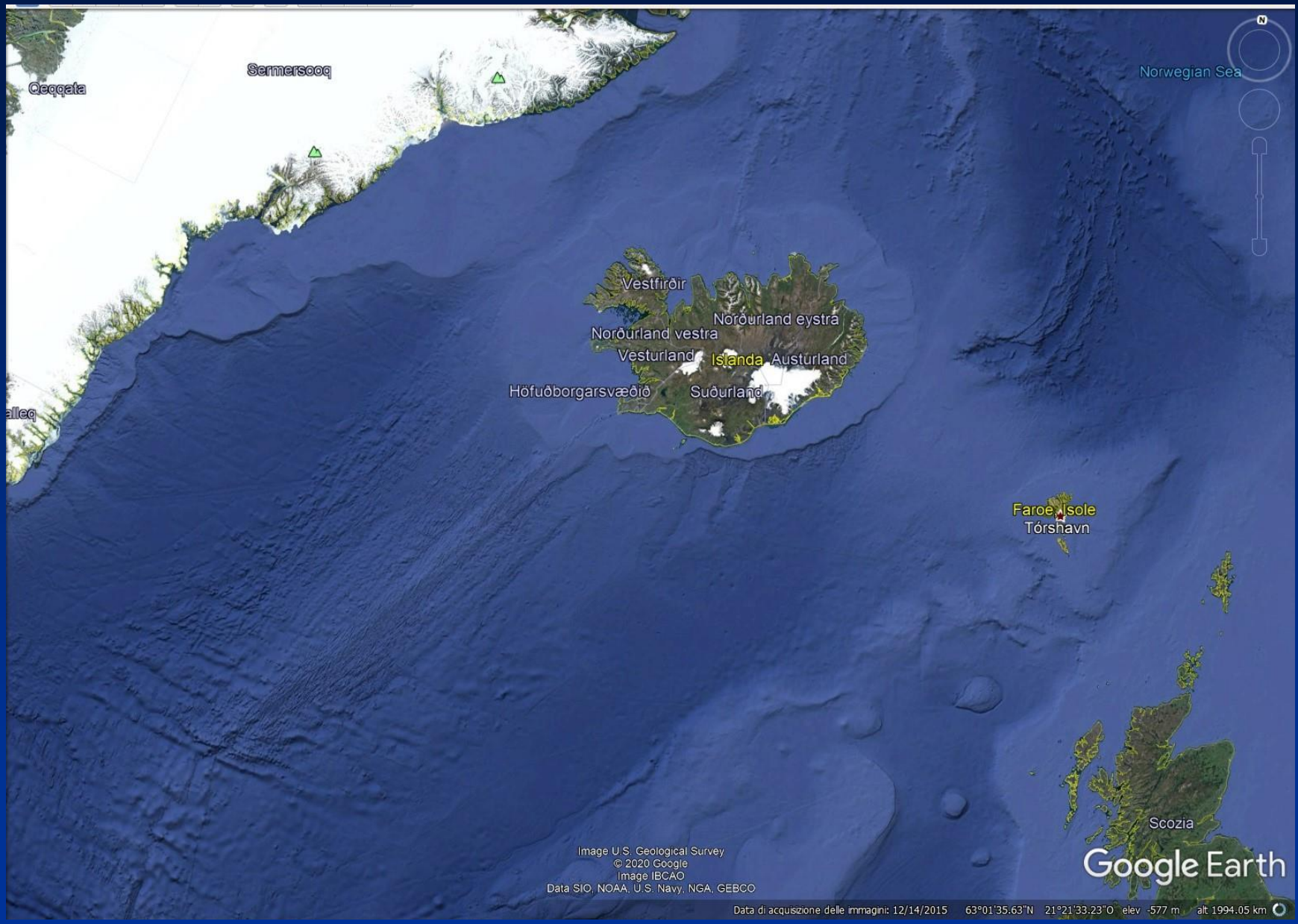

SW
NE
Cr
Ms
30 Ma
Ms
25–22 Ma
40
km
120
Ms
ASTHENOSPHERE
11 Ma

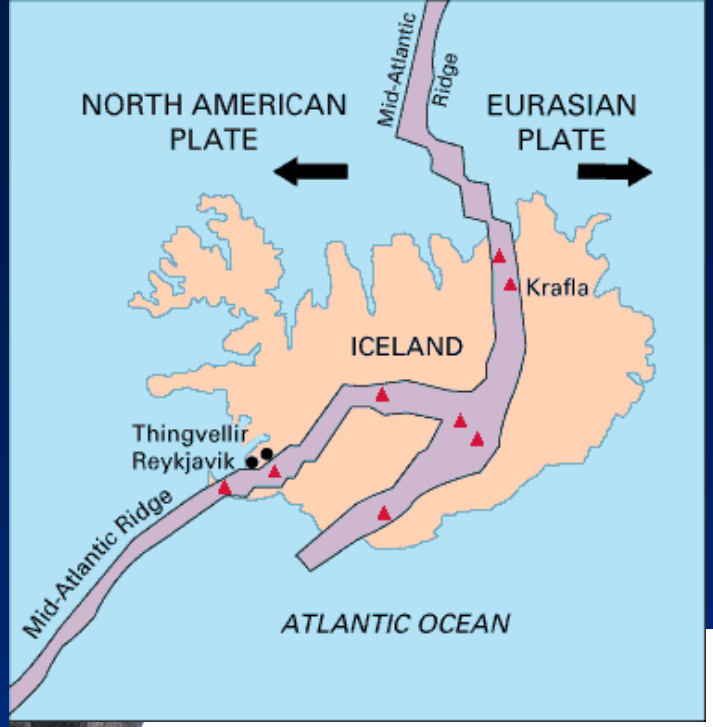


Da van der Pluijm & Marshak, 2004

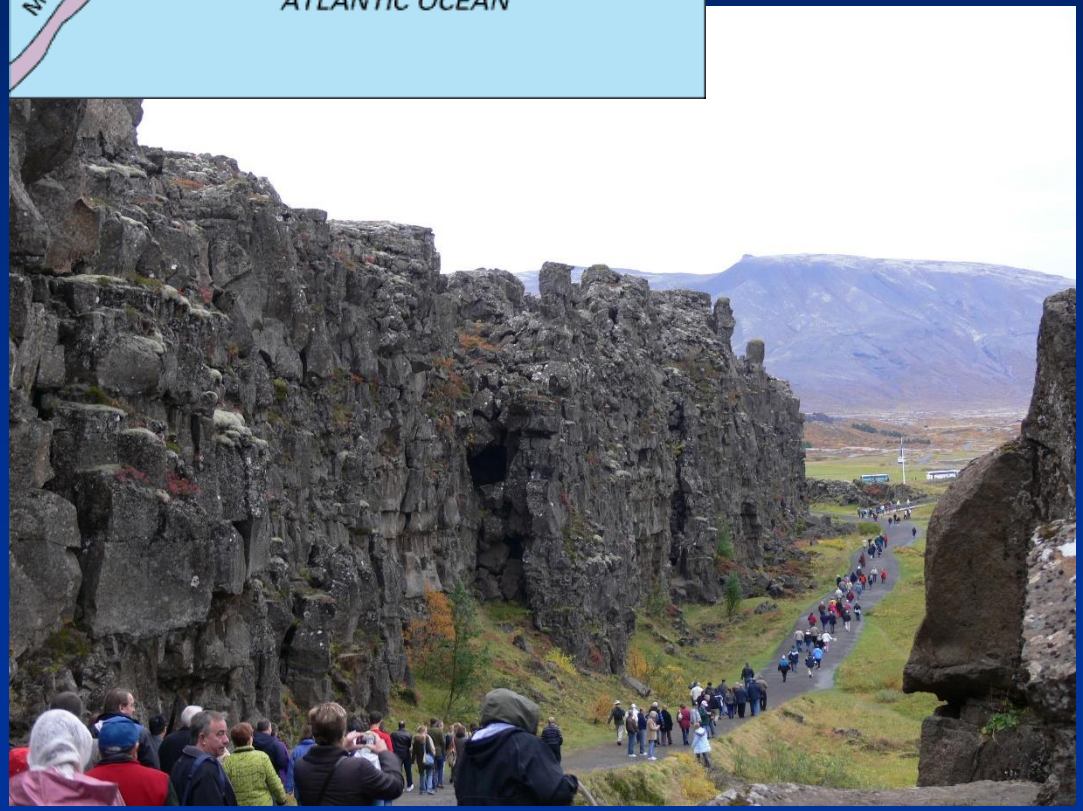


Da van der Pluijm & Marshak, 2004


Qeqqata
Sermersooq
Norwegian Sea
Vestfirðir
Norðurland eystra
Norðurland vestra
Vesturland
Ísland
Austurland
Höfuðborgarsvæðið
Suðurland
Faroe Isole
Tórshavn
Scozia
Image U.S. Geological Survey
© 2020 Google
Image IBCAO
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google Earth
Data di acquisizione delle immagini: 12/14/2015 63°01'35.63"N 21°21'33.23"O elev -577 m alt 1994.05 km

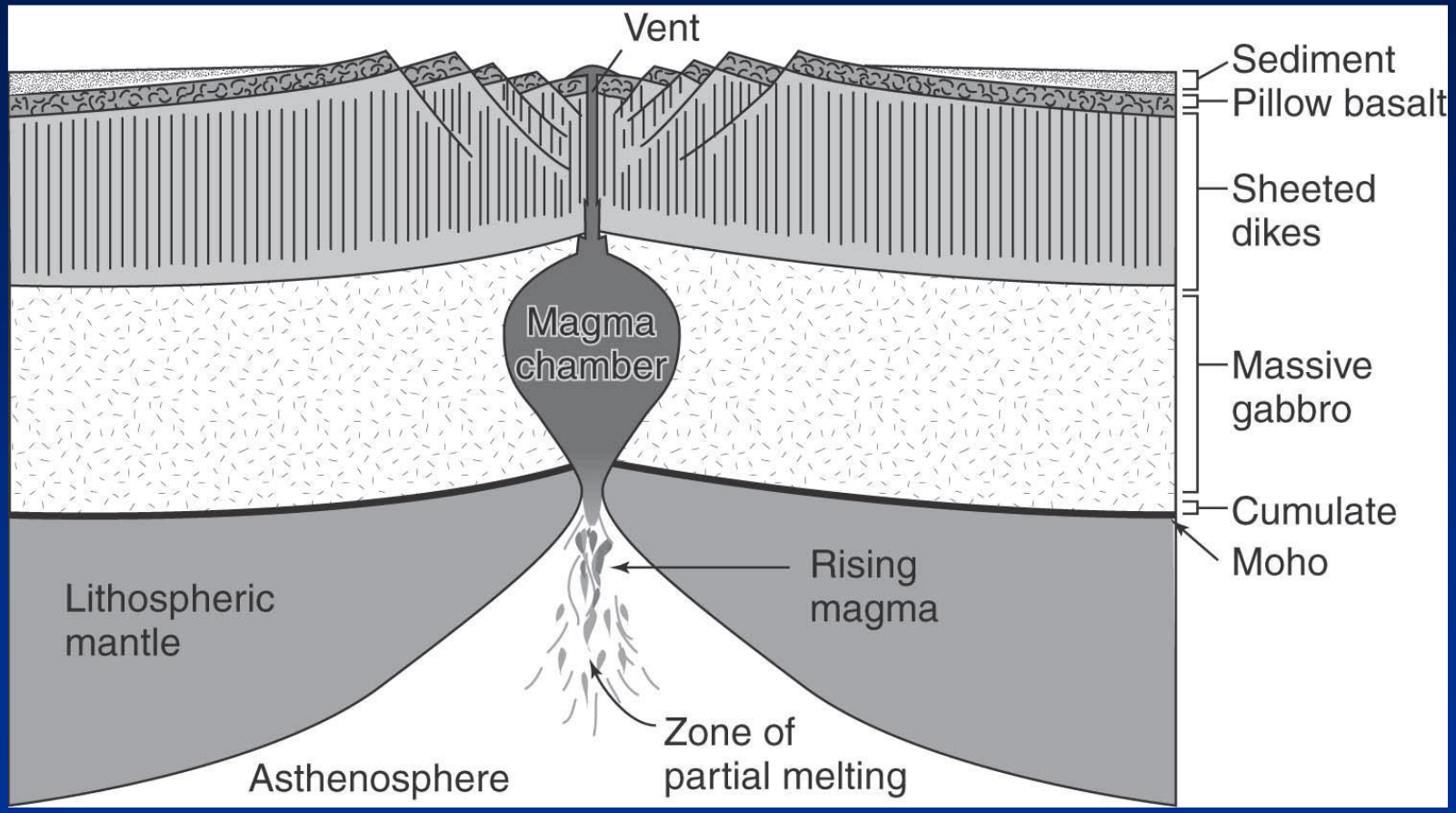


USGS: https://pubs.usgs.gov/gip/dynamic/understanding.html

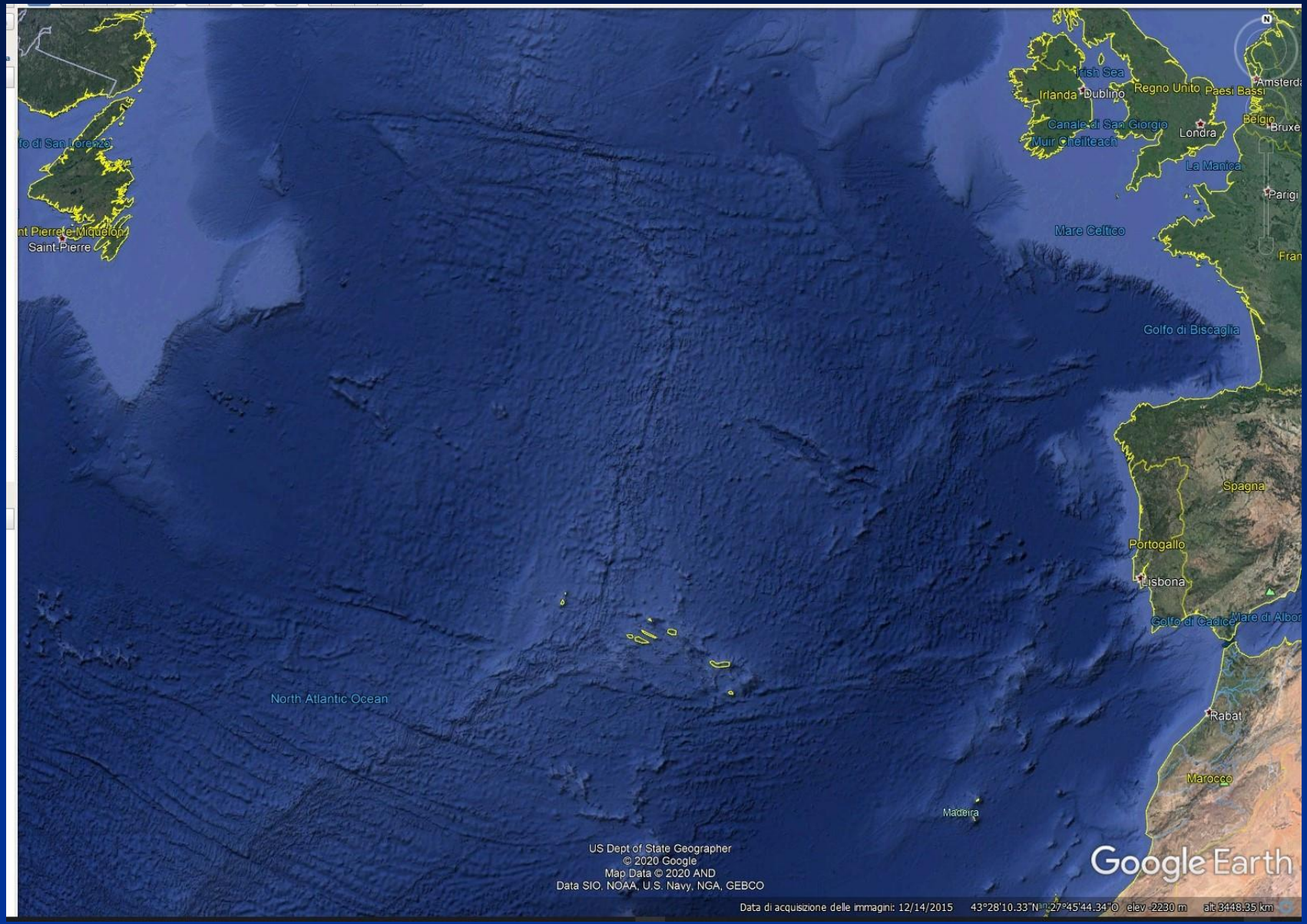


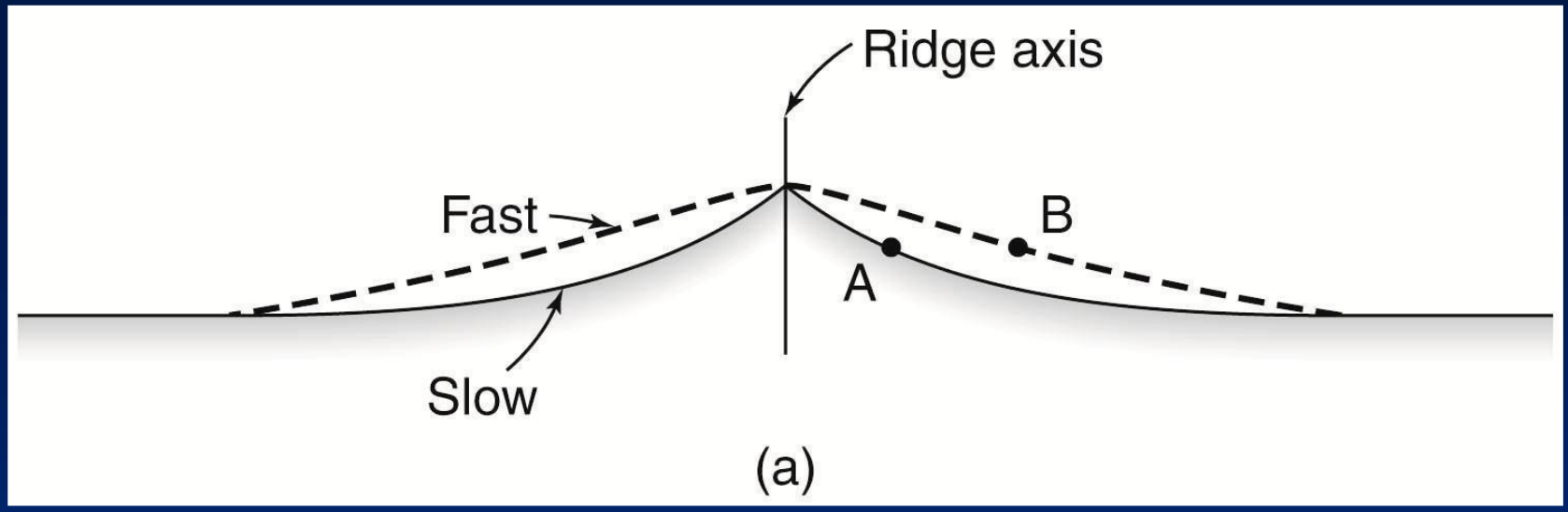
Thingvellir National Park, Iceland

https://commons.wikimedia.org/wiki/File:Iceland_mid_atlantic_ridge.JPG

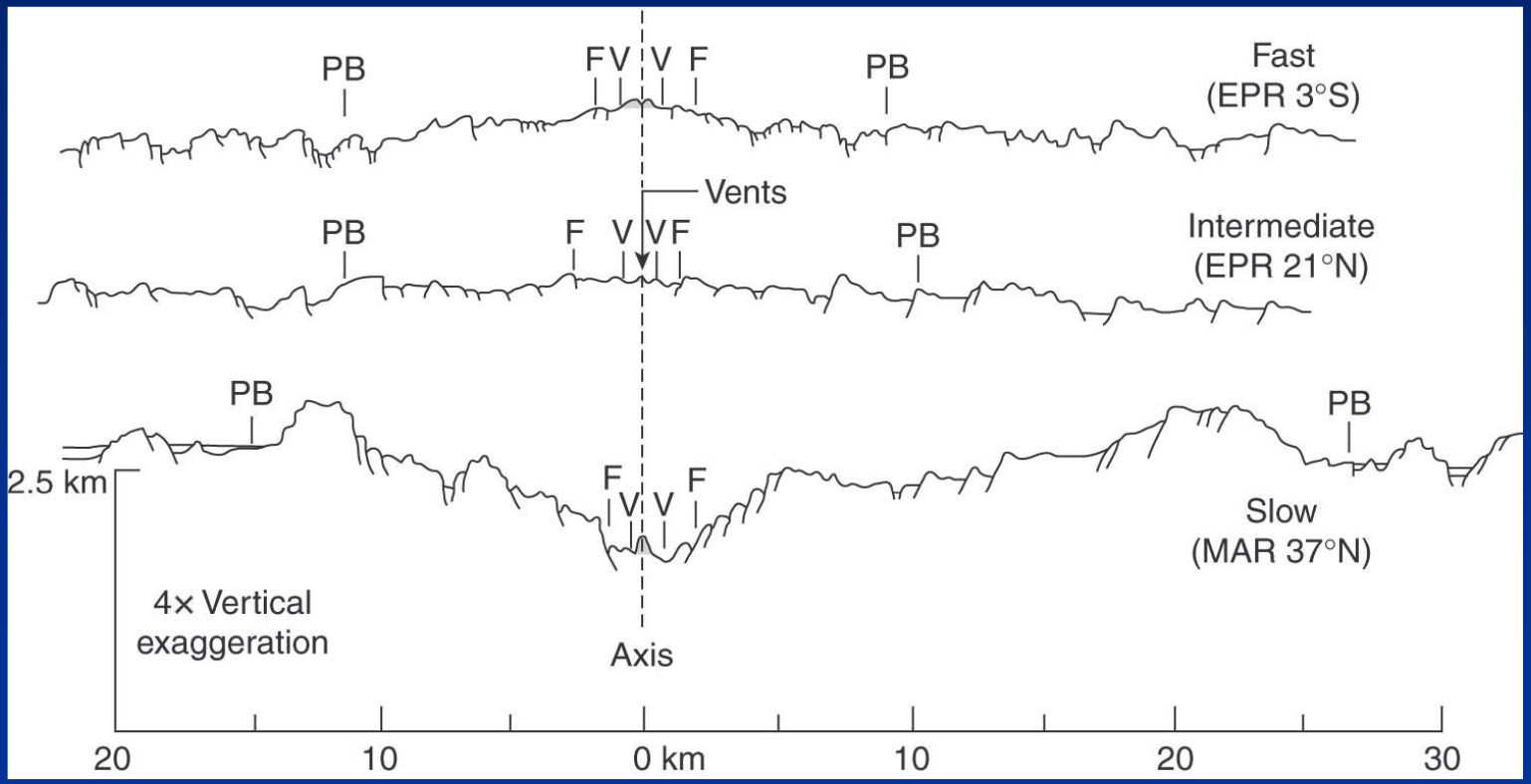


Da van der Pluijm & Marshak, 2004

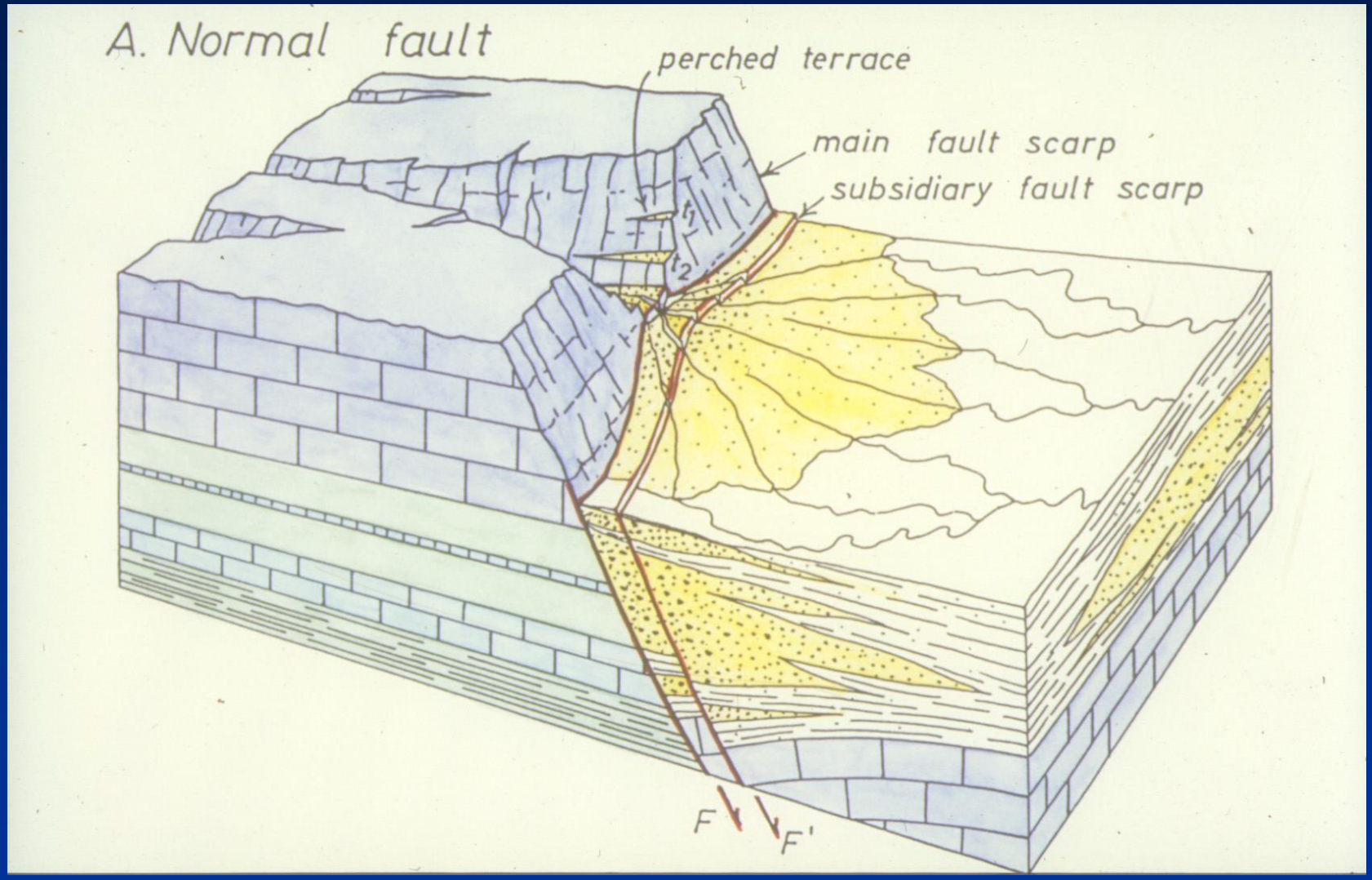

Irish Sea
Irlanda
Dublino
Regno Unito
Paesi Bassi
Amsterda
Belgio
Bruxe
Canale di San Giorgio
Muir nIcheltach
Londra
La Manica
Parigi
Mare Celtico
Fran
Golfo di Biscaglia
Spagna
Portogallo
Lisbona
Golfo di Cadice
Mare di Albor
North Atlantic Ocean
Rabat
Marocco
Madeira
Saint-Pierre
US Dept of State Geographer
© 2020 Google
Map Data © 2020 AND
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google Earth
Data di acquisizione delle immagini: 12/14/2015
43°28'10.33"N 27°45'44.34"O elev -2230 m alt 3448.35 km



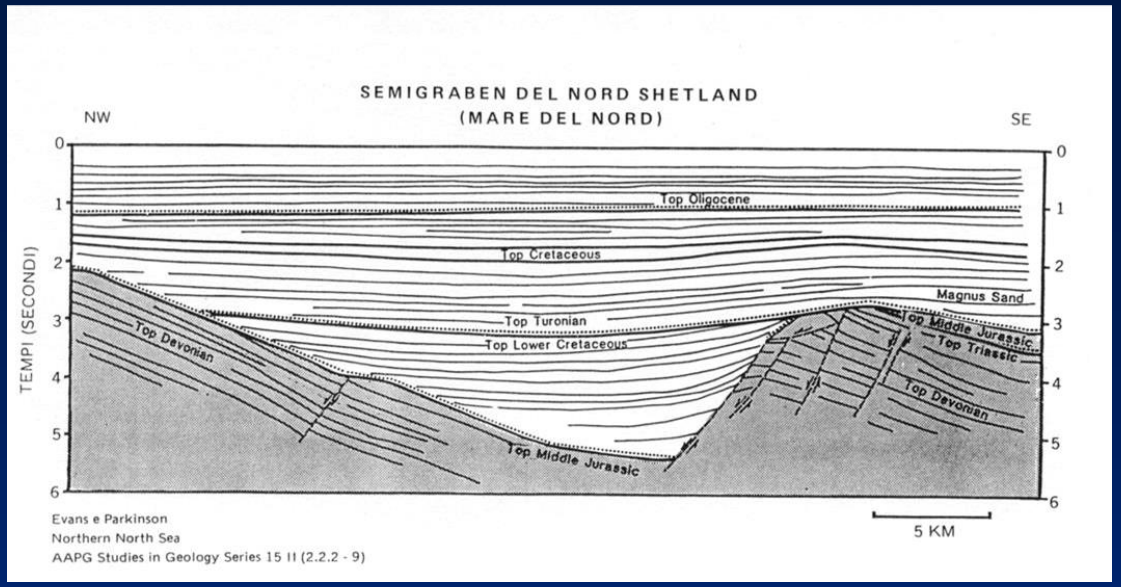
Da van der Pluijm & Marshak, 2004



Faglia normale associata ad erosione (letto) e deposizione (sul lembo di tetto). La forma del bacino sedimentario e la stratigrafia dei depositi è controllata dalla attività della faglia



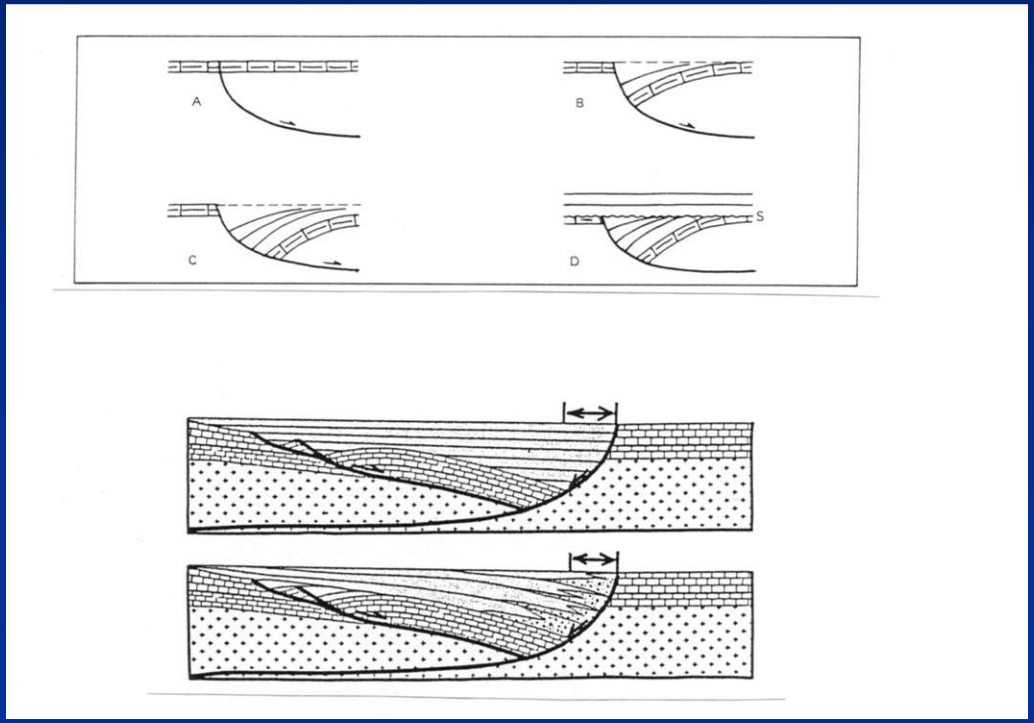
Da Ramsay and Huber, 1987

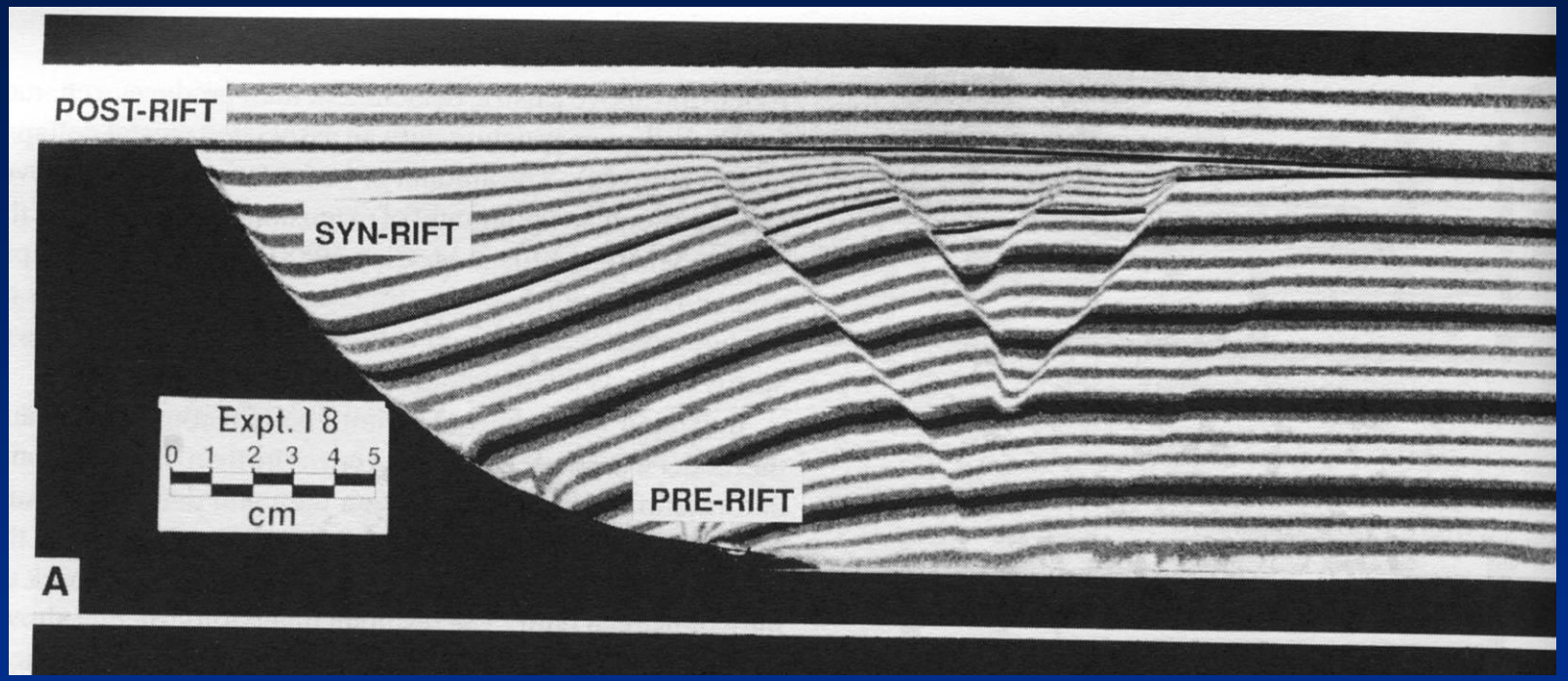


Velocità di attivazione della faglia elevata, basso tasso di sedimentazione

Tasso di sedimentazione elevato, movimento della faglia protratto nel tempo.

I due casi precedenti a confronto





Depositi di pre-, sin- e post-rift.