EXTENZNÍ PÁNVE

(Pánve vzniklé natahováním litosféry)

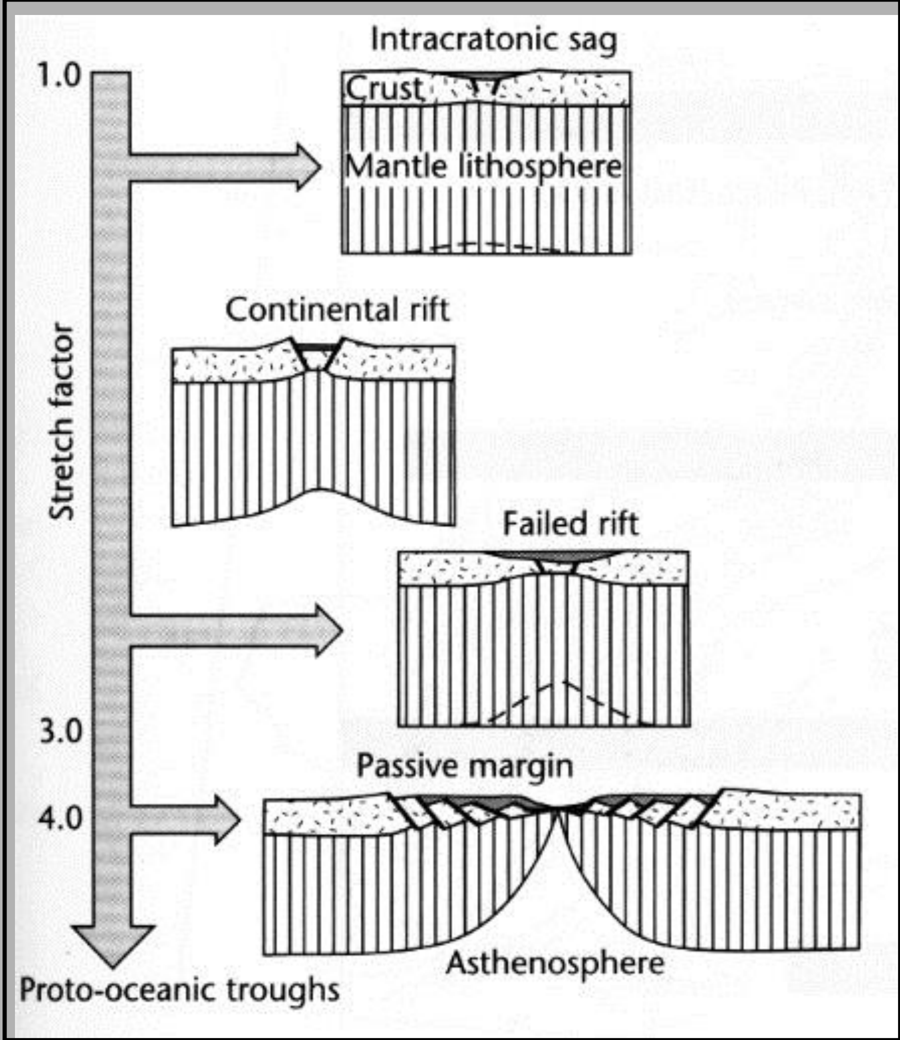
intracratonic sags, rifty, pasivní okraje

-všechny tyto pánve vznikají v extenzním režimu

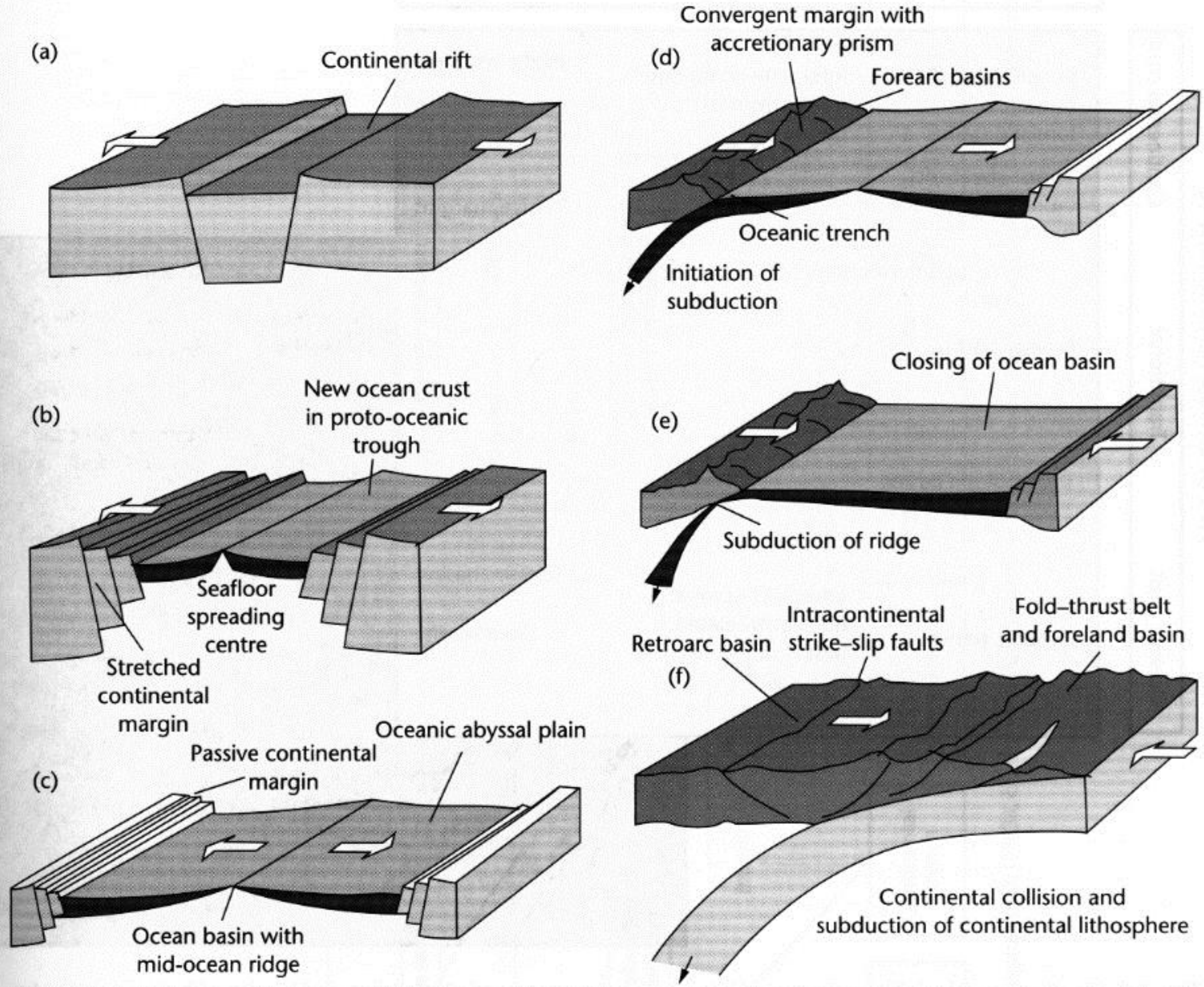
Projevy extenze

- **křehké** ⇒ rifty
- **duktilní** ⇒ intracratonic sags

  (není překročena pevnost hornin)



THE WILSON CYCLE



RIFTOVÉ PÁNVE

RIFT

-příkopová struktura nebo systém příkopových struktur vzniklý v oblasti **ztenčení kůry** a vymezený soustavou poklesových zlomů.

- mělká hloubka MOHO
- vysoký tepelný tok při povrchu
- vulkanická aktivita
- negativní Bouguerovy tíhové anomálie
- často vyzdvižené okraje riftové struktury

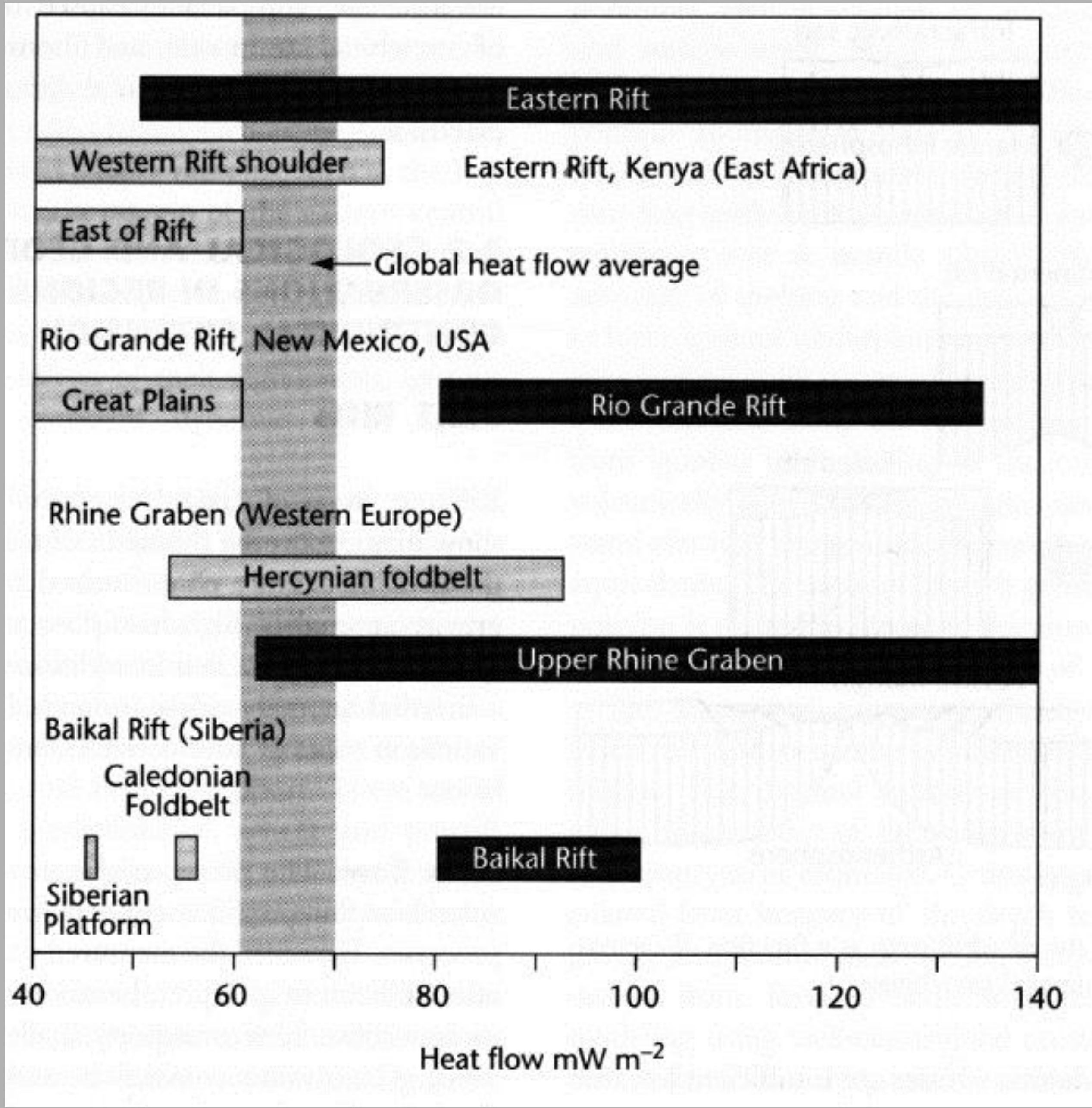
TEPELNÝ TOK

Vulkanická činnost a zvýšený tepelný tok dokládají zvýšenou aktivitu termálních procesů.

Průmerný tepelný tok v riftových oblastech **90-110 mWm^{-2}**

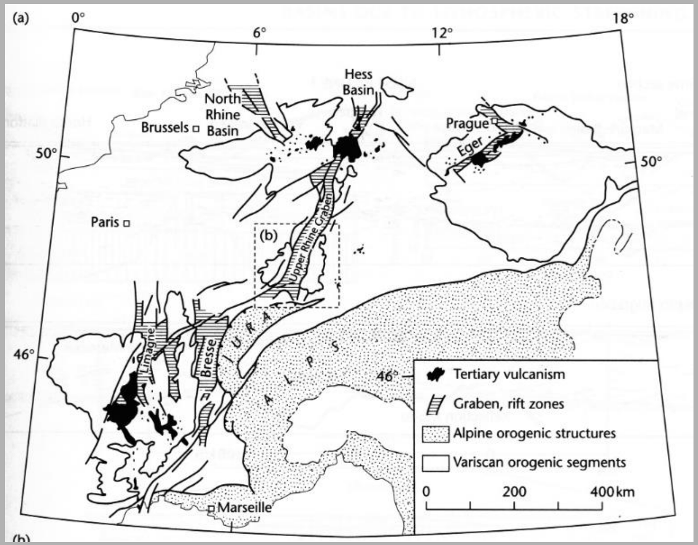
⇒ to je 2x více než v “neriftovaném“ okolí

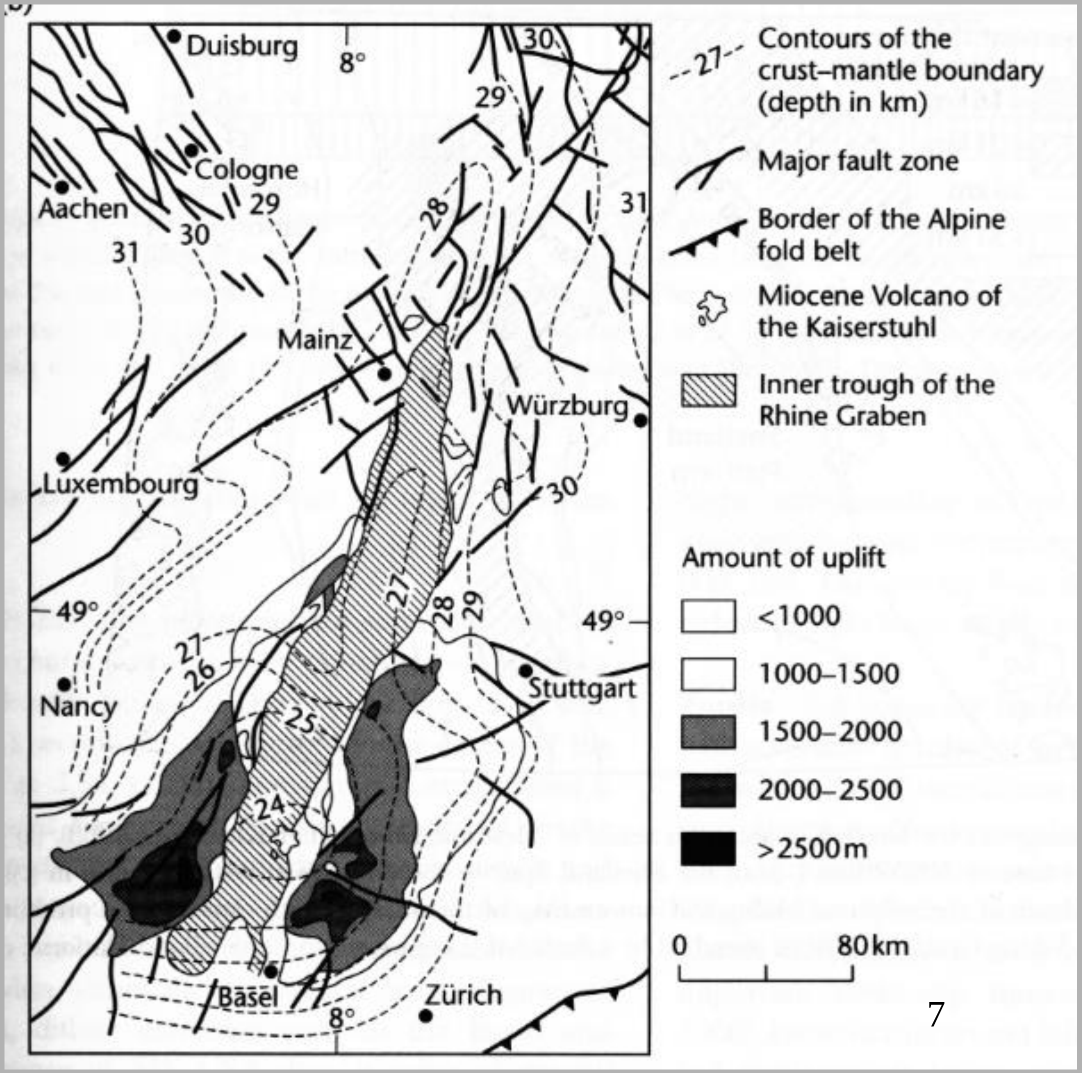
Hodnota tepelného toku závisí rovněž na horninovém složení (granity mají vyšší tok než bazika nebo sedimenty).


Eastern Rift
Western Rift shoulder
Eastern Rift, Kenya (East Africa)
East of Rift
Global heat flow average
Rio Grande Rift, New Mexico, USA
Great Plains
Rio Grande Rift
Rhine Graben (Western Europe)
Hercynian foldbelt
Upper Rhine Graben
Baikal Rift (Siberia)
Caledonian Foldbelt
Baikal Rift
Siberian Platform
40
60
80
100
120
140
Heat flow mW m−2

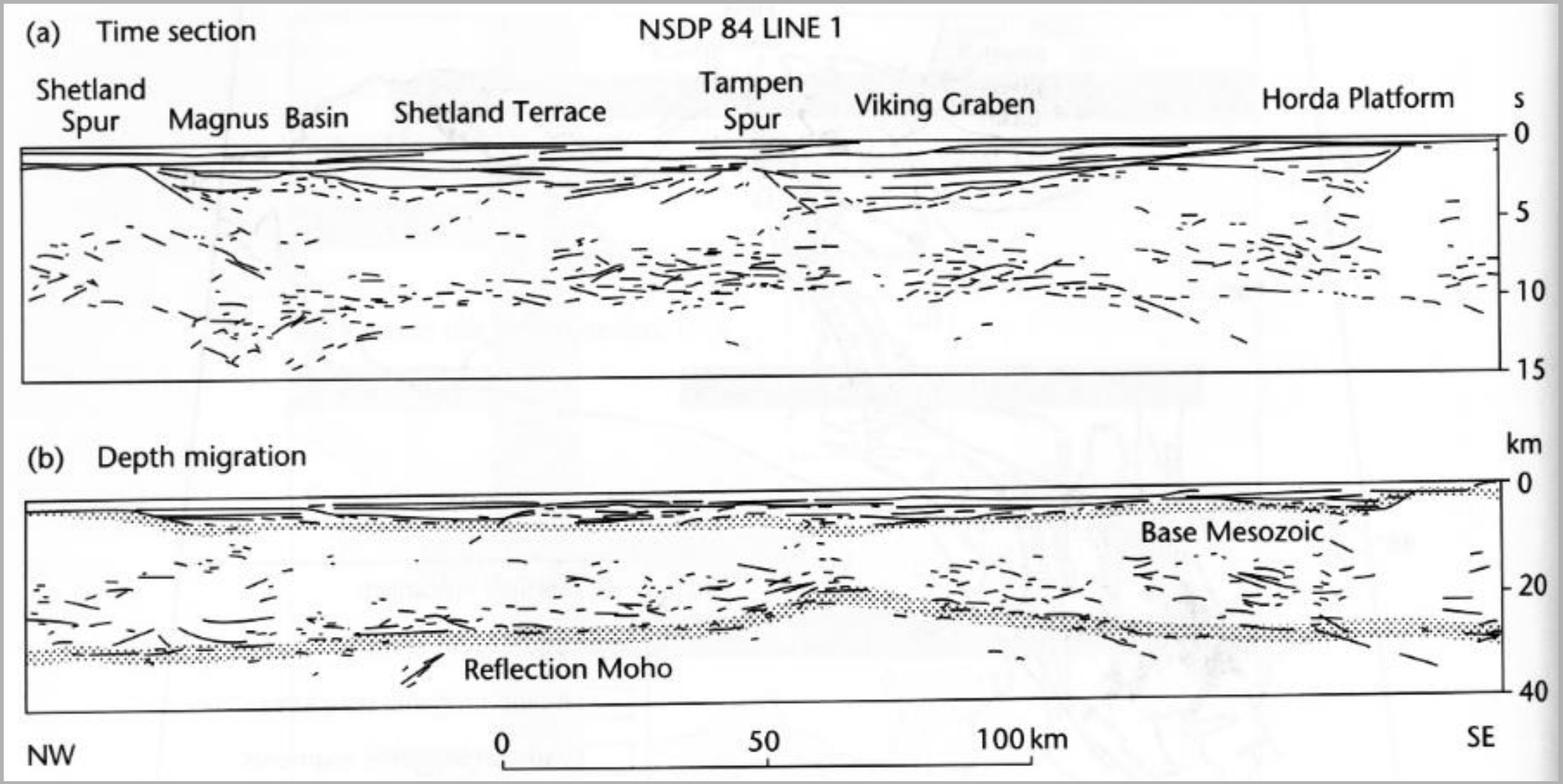
MOCNOST KŮRY

Vyklenování MOHO v místě riftingu ⇒ ztenčení kůry

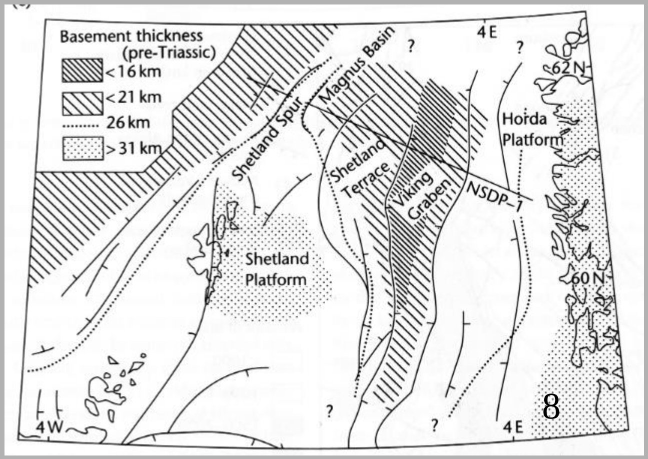




Allen and Allen, 2005



Oblast severního moře – rifting v mesozoiku

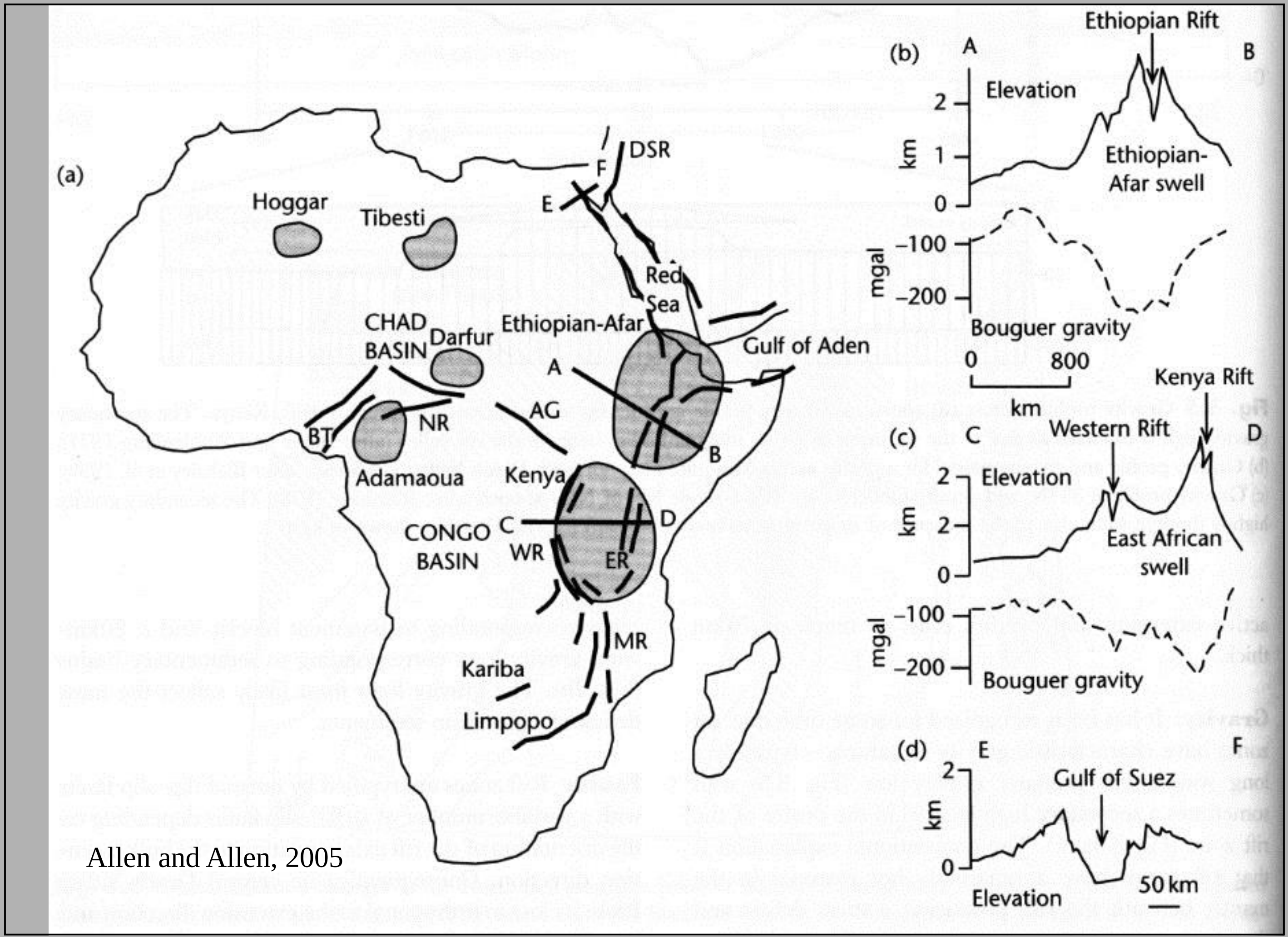


Allen and Allen, 2005

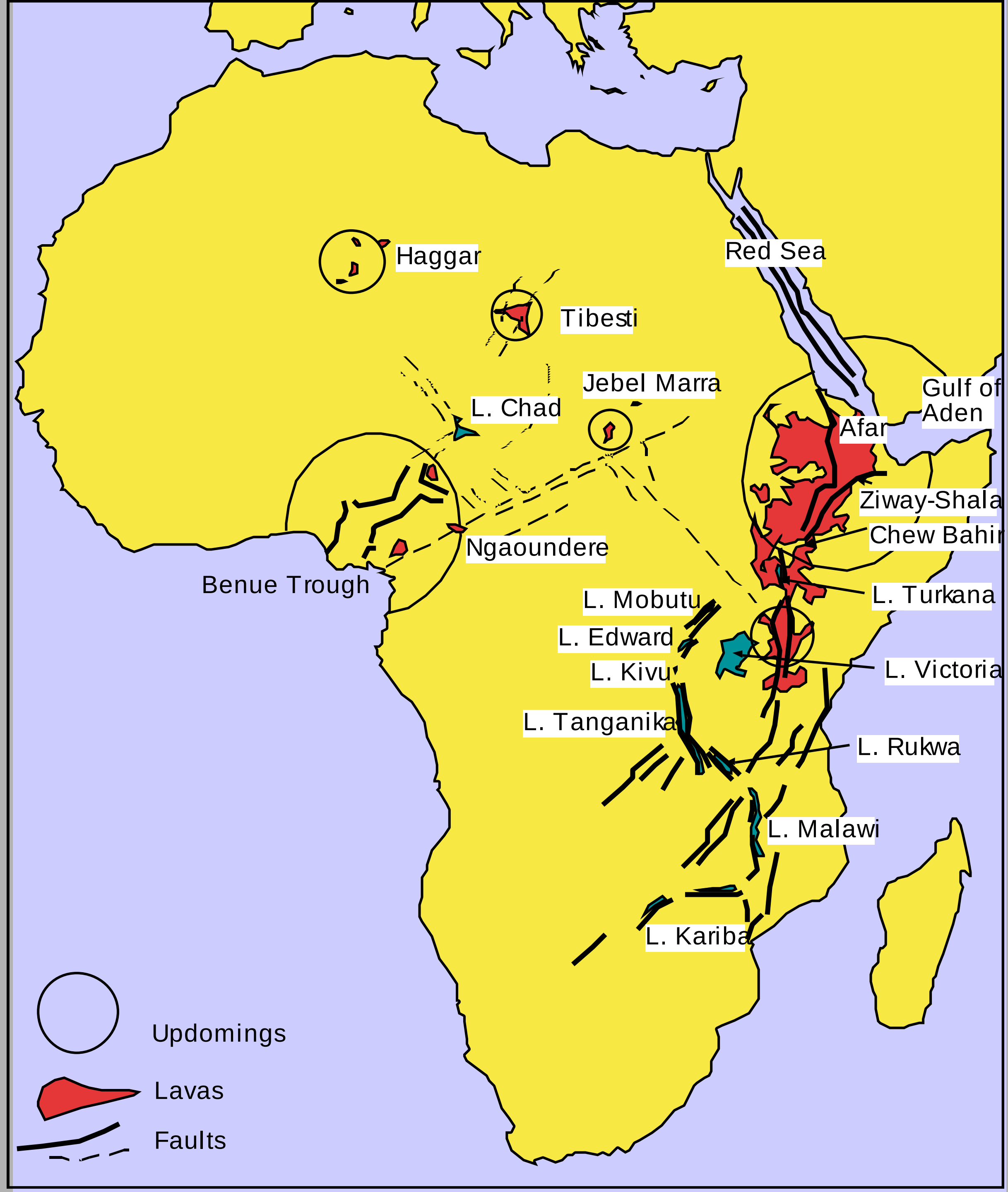
TOPOGRAFIE

- současné rifty jsou typické **vyzdviženými** okraji

⇒ **eroze** (např. obnažení Herc. krystalinika v oblasti Vosges a Černého lesa v případě výzdvihu okrajů riftu Rhine Graben)



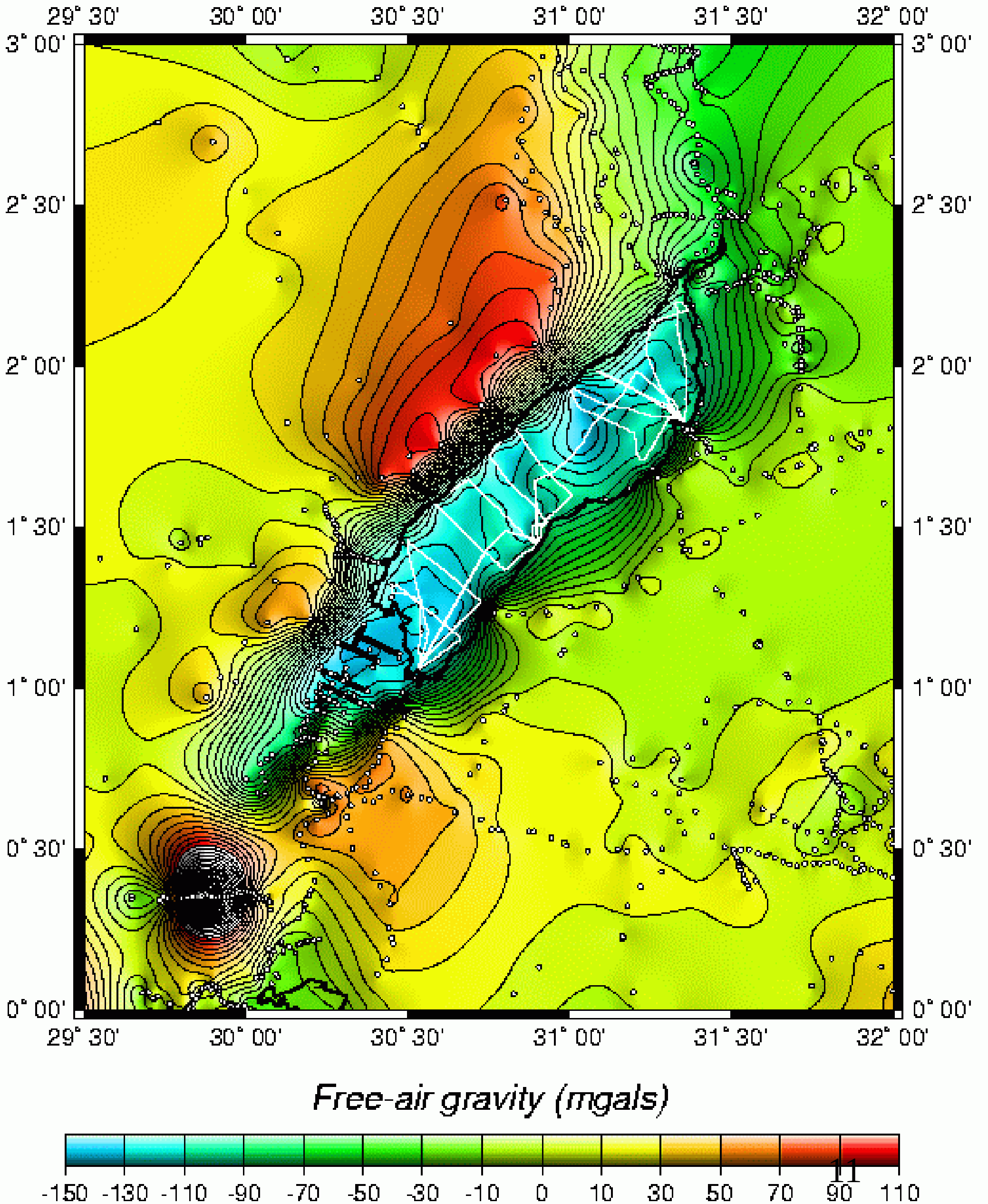
Allen and Allen, 2005


Haggar
Tibesti
Red Sea
Jebel Marra
L. Chad
Gulf of
Aden
Afar
Ziway-Shala
Chew Bahir
Ngaoundere
Benue Trough
L. Mobutu
L. Turkana
L. Edward
L. Kivu
L. Victoria
L. Tanganika
L. Rukwa
L. Malawi
L. Kariba
Updomings
Lavas
Faults

GRAVIMETRIE

Zóna riftingu – pod povrchem prohřátý materiál

⇒ **negativní tíhové anomálie**



Free-air gravity contour map of the Albertine rift system

ČASOVÉ MĚŘÍTKO a VELIKOST EXTENZE

- rychlost rozpínání < 1 mm/rok
- doba rozpínání 10 - 30 mil. let s celkovou extenzí do 10 km

  (platí pro rifty na normálně mocné kůře; např. Rhine Graben, Bajkal, Rio Grande)

MODELY KONTINENTÁLNÍ EXTENZE

AKTIVNÍ a PASIVNÍ rifting – idealizované koncové modely

❑ **AKTIVNÍ RIFTING**

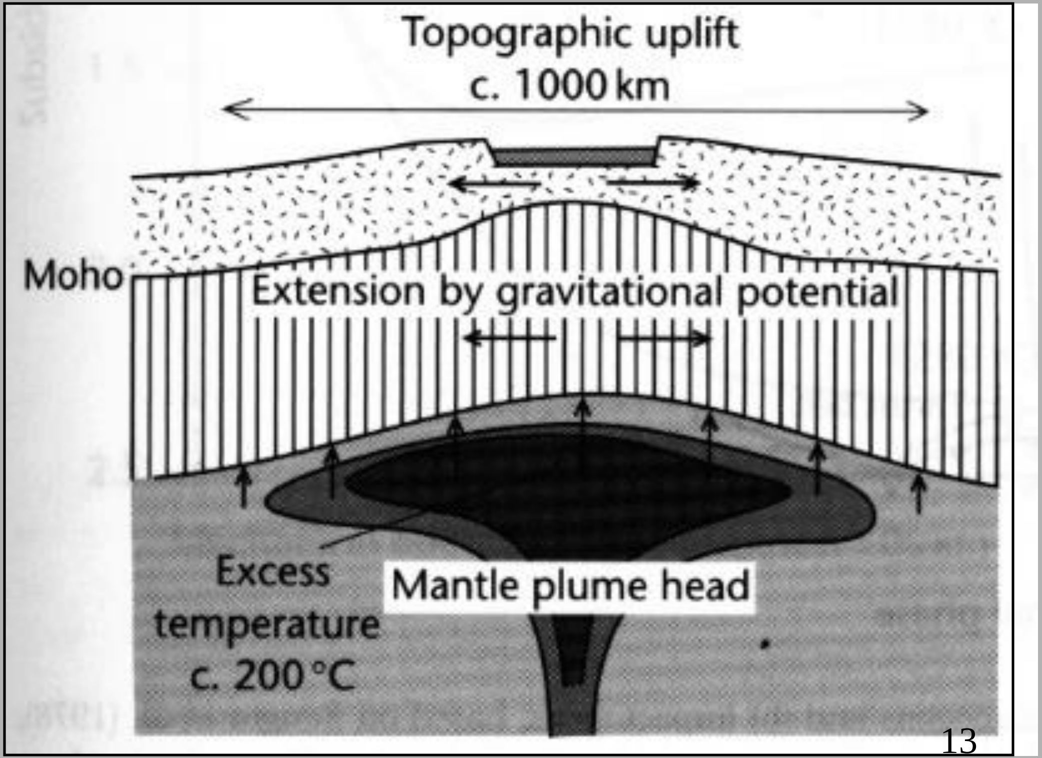
prohřátí a následné **ztenčení** litosféry nad plášťovým plumem

⇒ **vyklenování** (v důsledku zvýšeného teplotního toku a prohřátí)

⇒ **tenzní napětí**

⇒ **rifting**

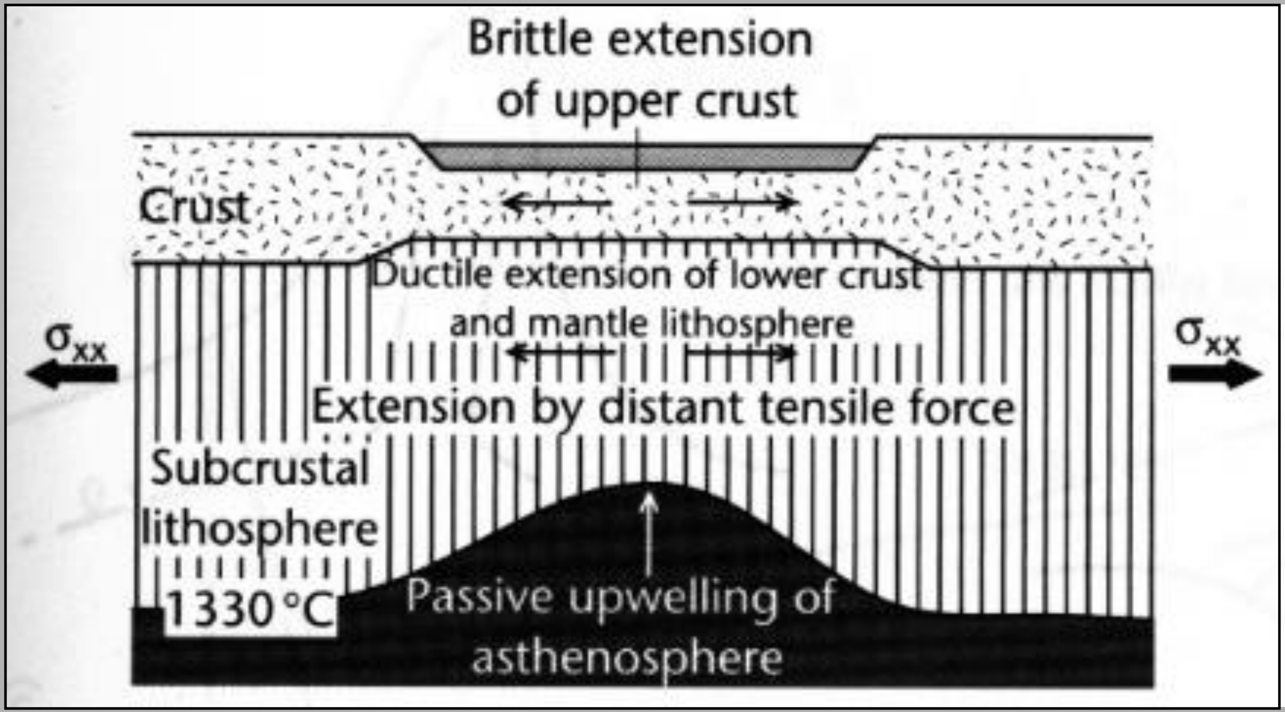
(např. East Africa Rift)



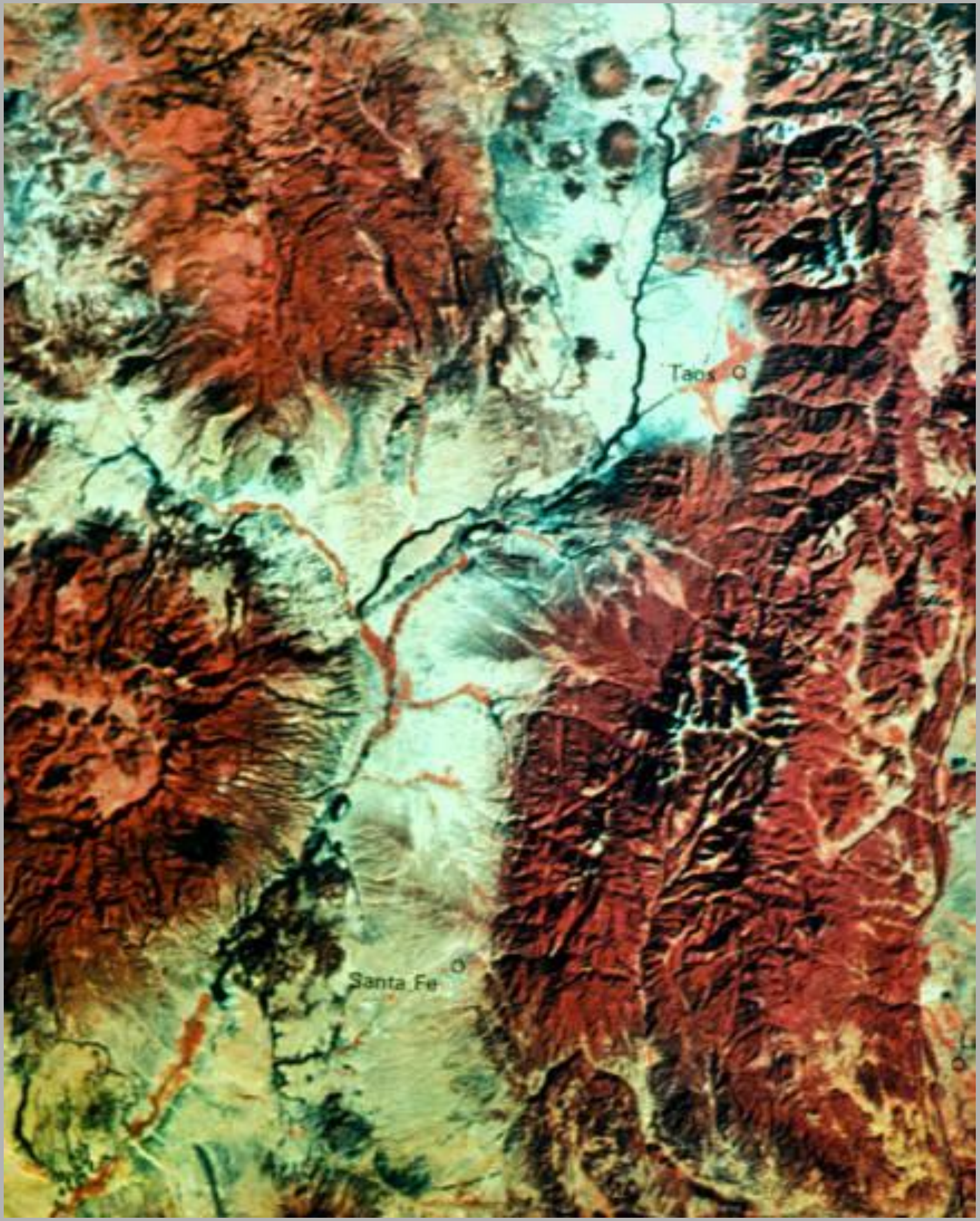
Allen and Allen, 2005

❑ **PASIVNÍ RIFTING**
- **ztenčení** a **porušení** kontinentální litosféry v důsledku **tenze**
  ⇒ vyklenování a vulkanická činnost (druhotné procesy)

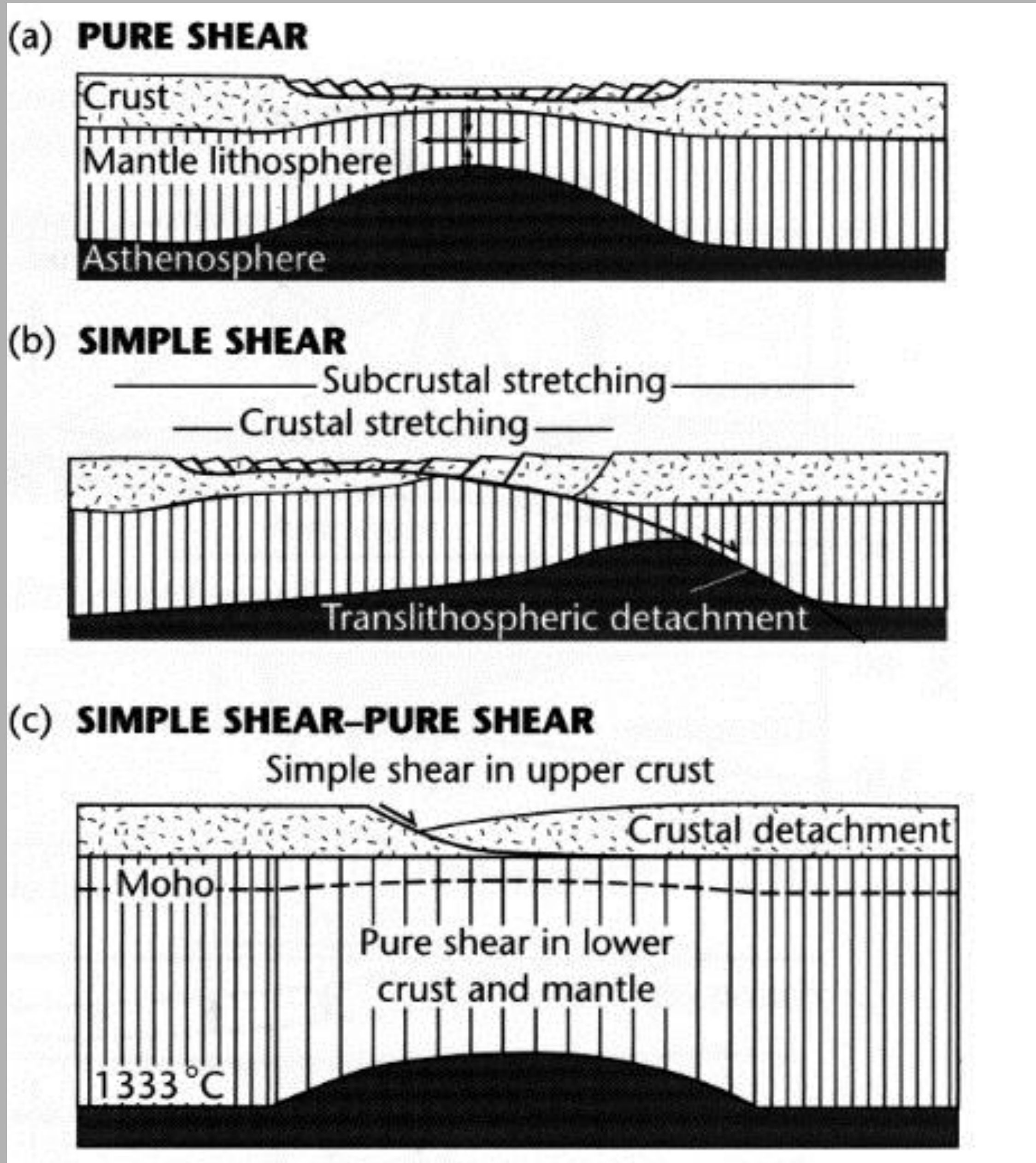
  (např. Rift Rio Grande)



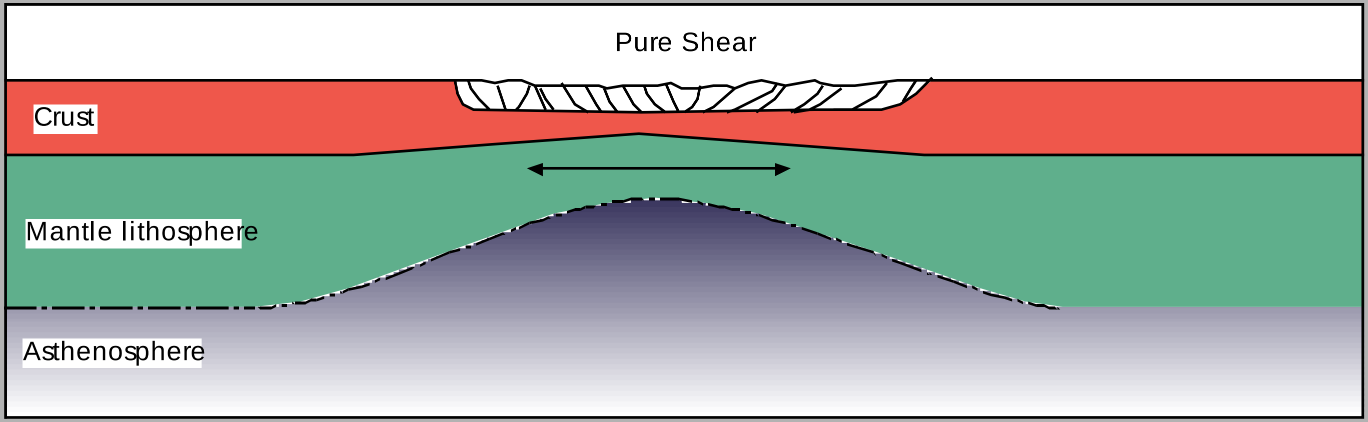
Allen and Allen, 2005

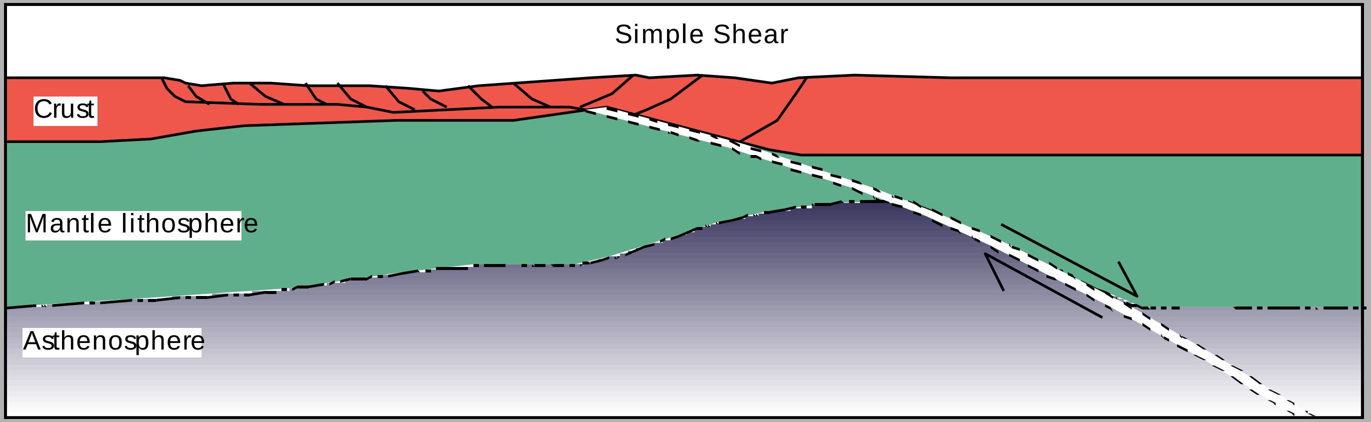


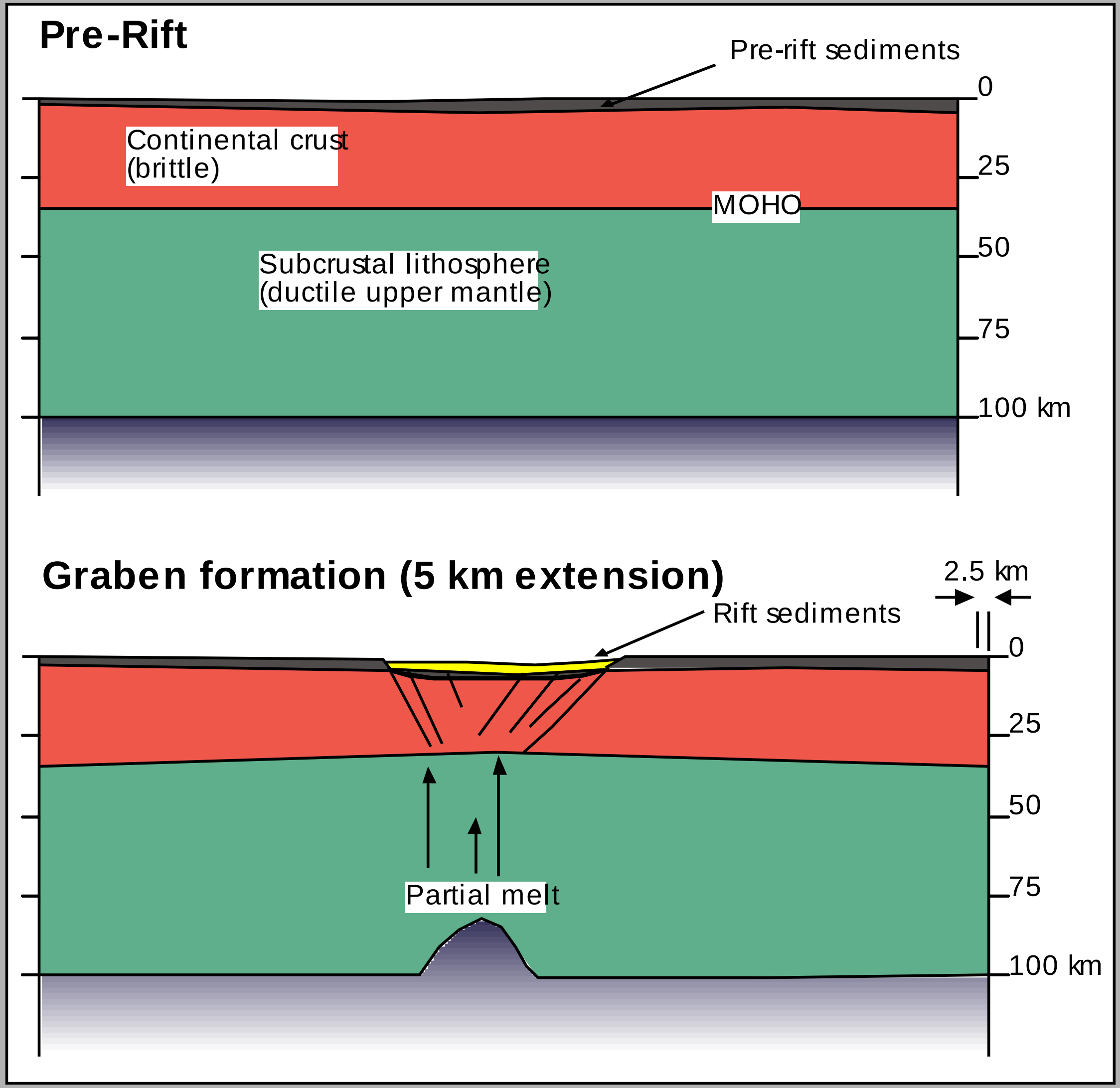
Taos
Santa Fe

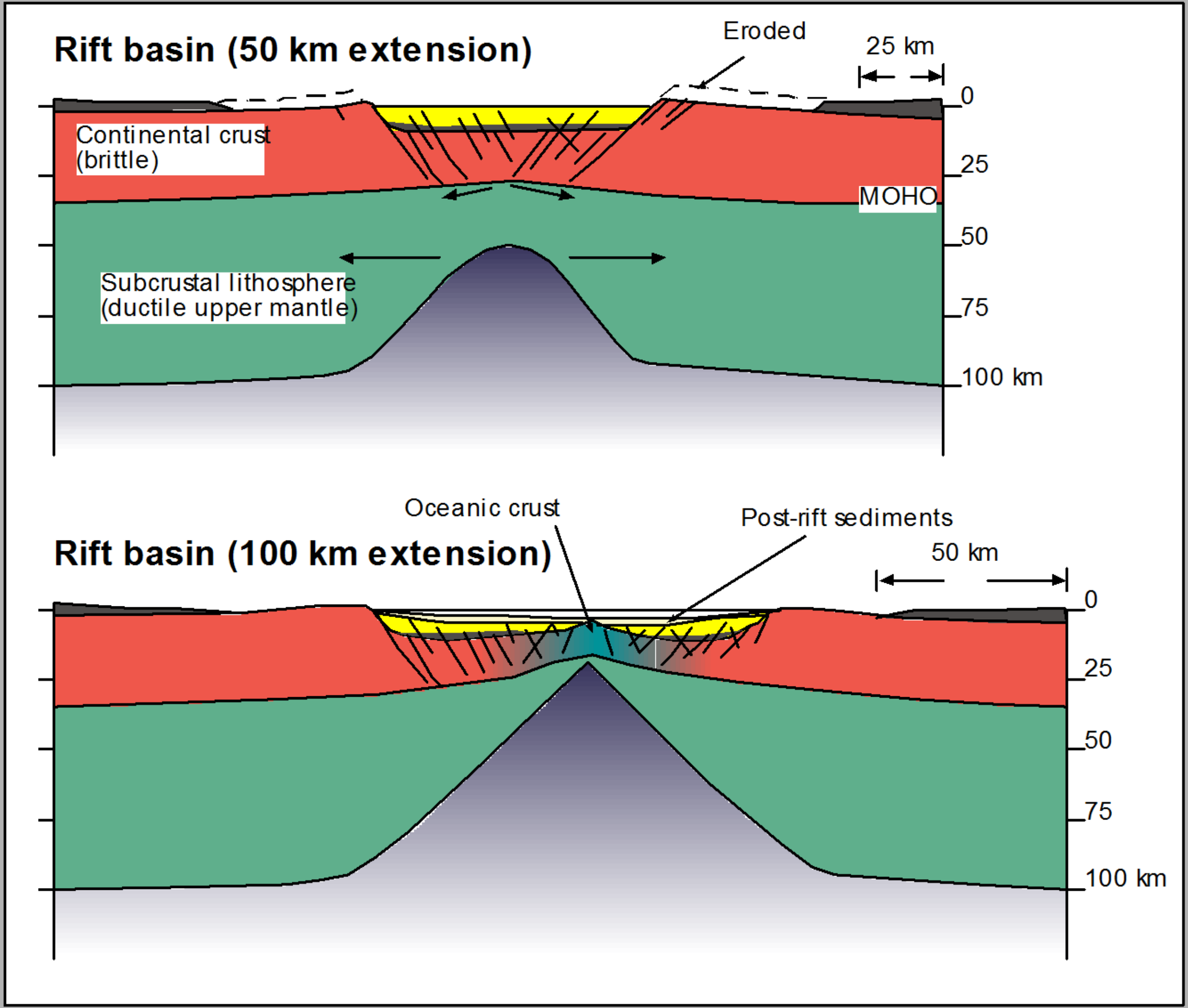


Allen and Allen, 2005

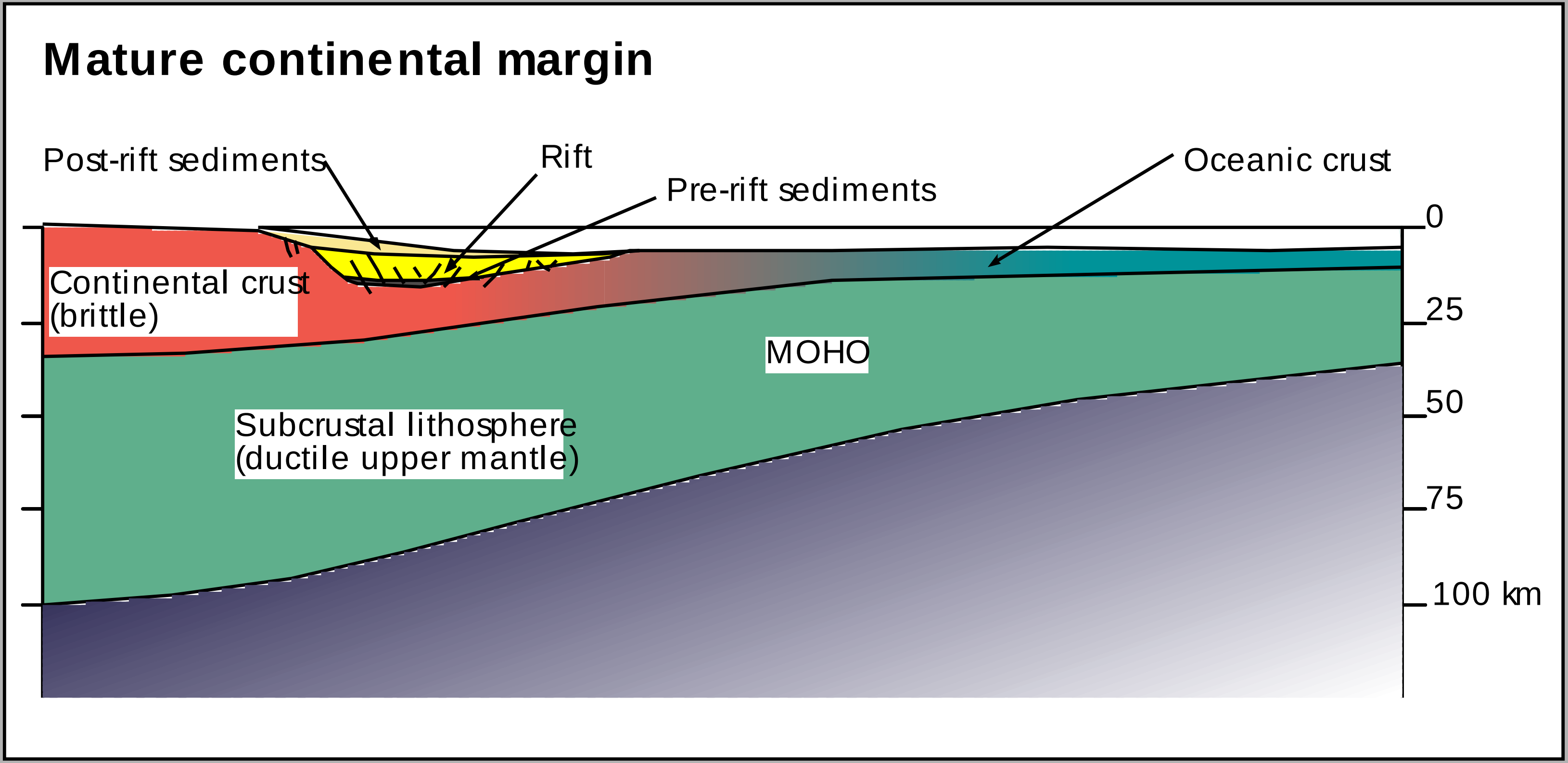

Pure Shear
Crust
Mantle lithosphere
Asthenosphere

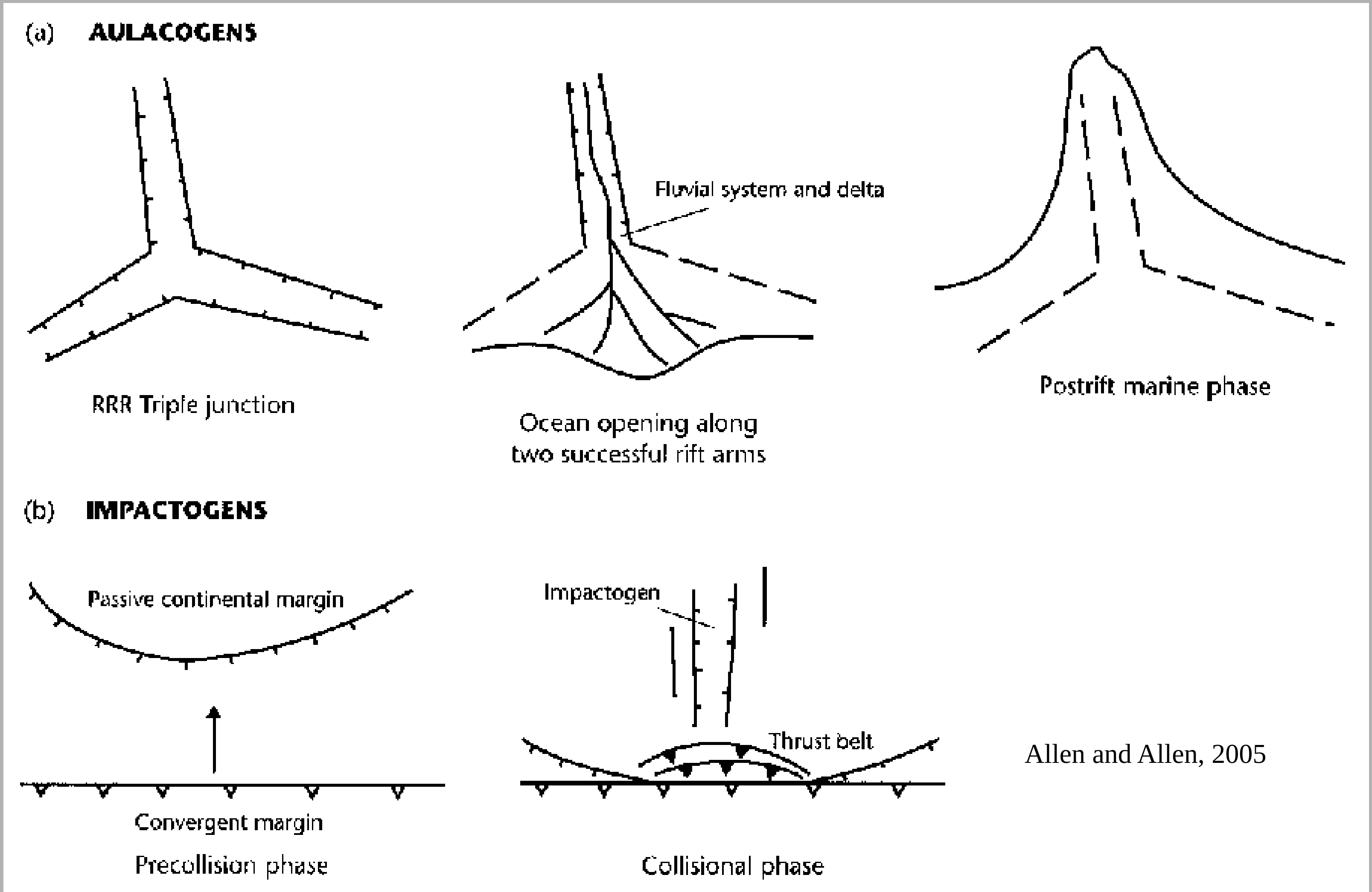

Simple Shear
Crust
Mantle lithosphere
Asthenosphere


Pre-Rift
Pre-rift sediments
0
Continental crust
(brittle)
25
MOHO
50
Subcrustal lithosphere
(ductile upper mantle)
75
100 km
Graben formation (5 km extension)
2.5 km
Rift sediments
0
25
50
75
Partial melt
100 km


Rift basin (50 km extension)
Eroded
25 km
0
25
50
75
100 km
Continental crust
(brittle)
MOHO
Subcrustal lithosphere
(ductile upper mantle)
Rift basin (100 km extension)
Oceanic crust
Post-rift sediments
50 km
0
25
50
75
100 km

pasivní kontinentální okraj



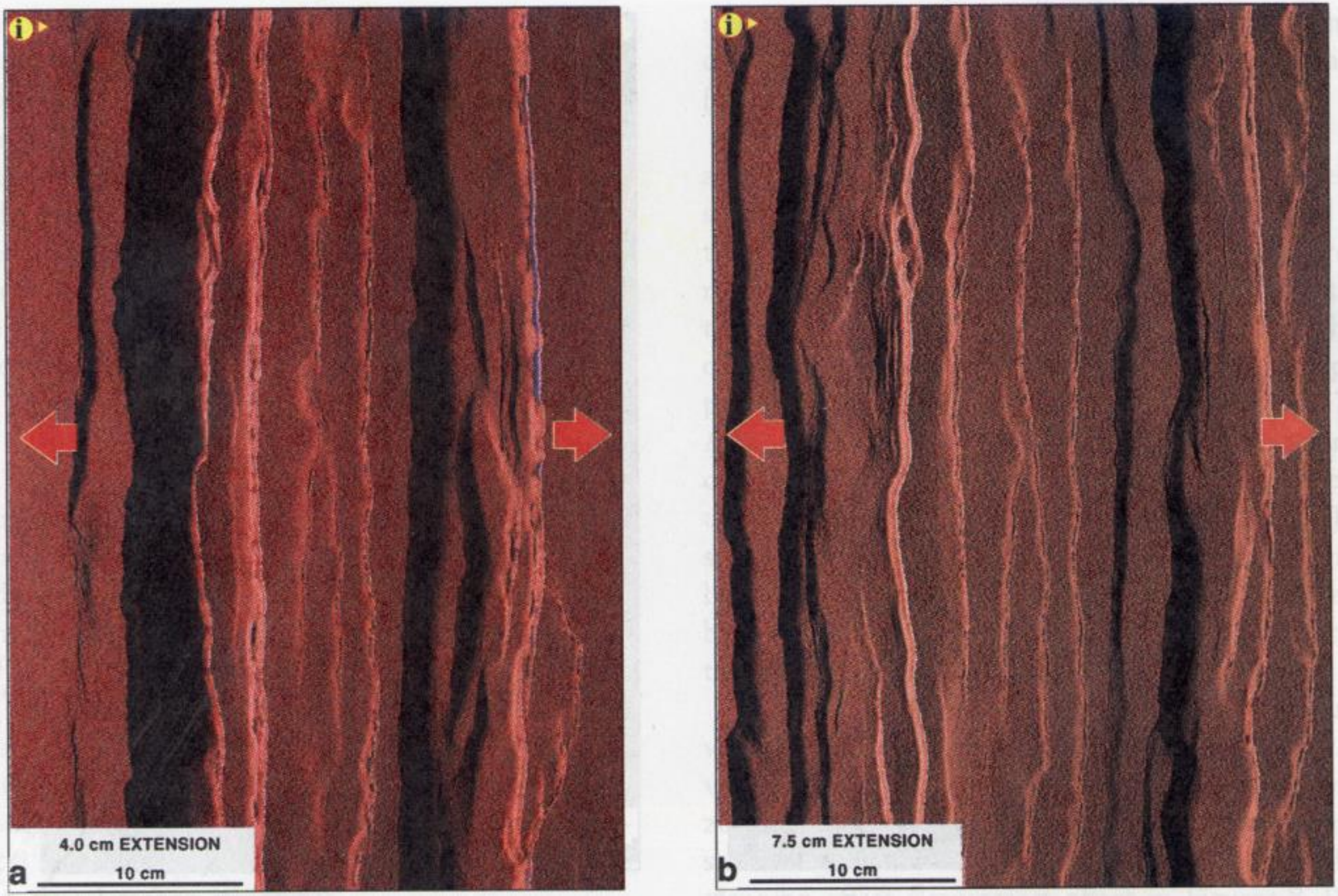


Allen and Allen, 2005

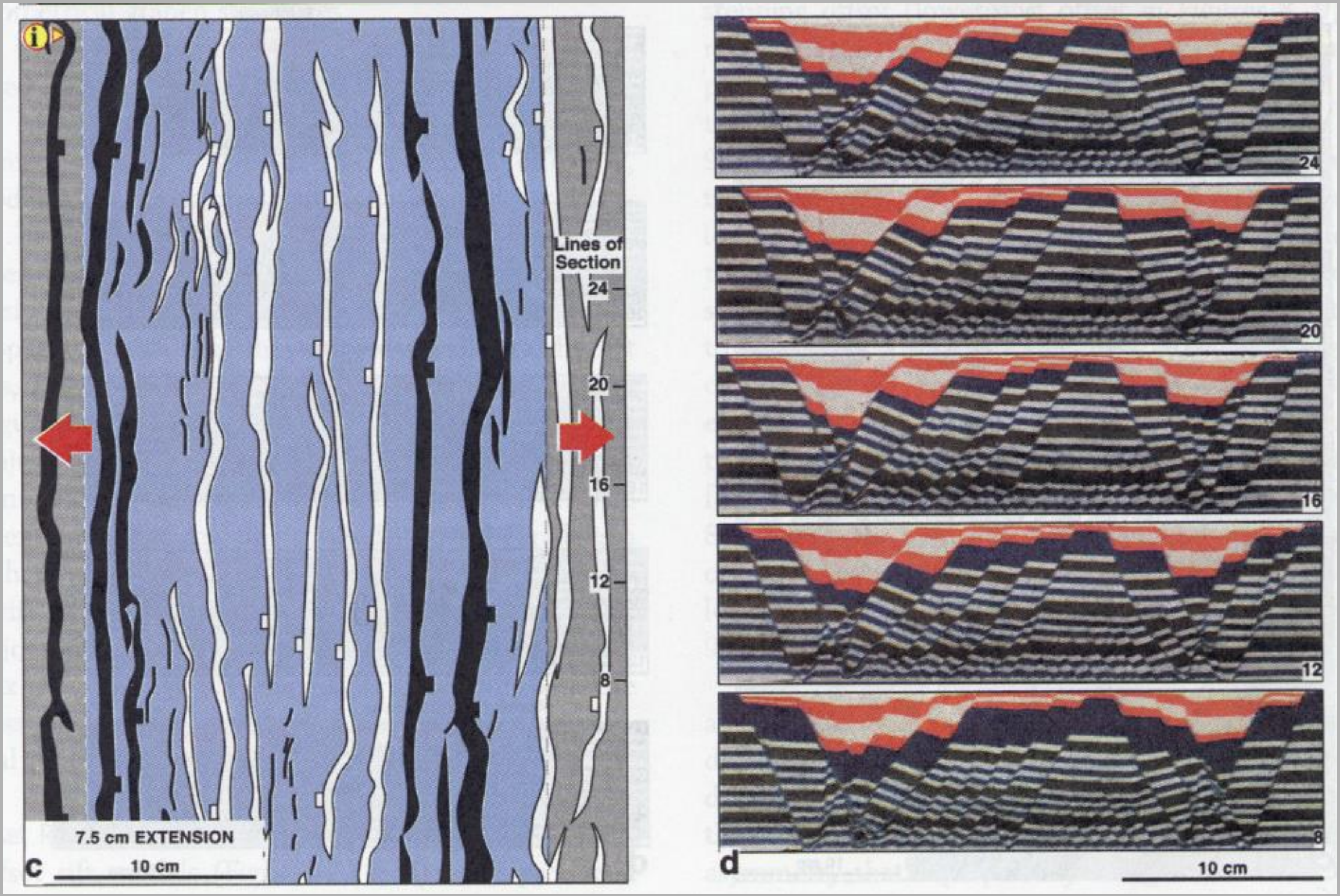
ARCHITEKTURA RIFTOVÝCH PÁNVÍ:
ZLOMOVÉ SYSTÉMY A GEOMETRIE DEPOCENTER

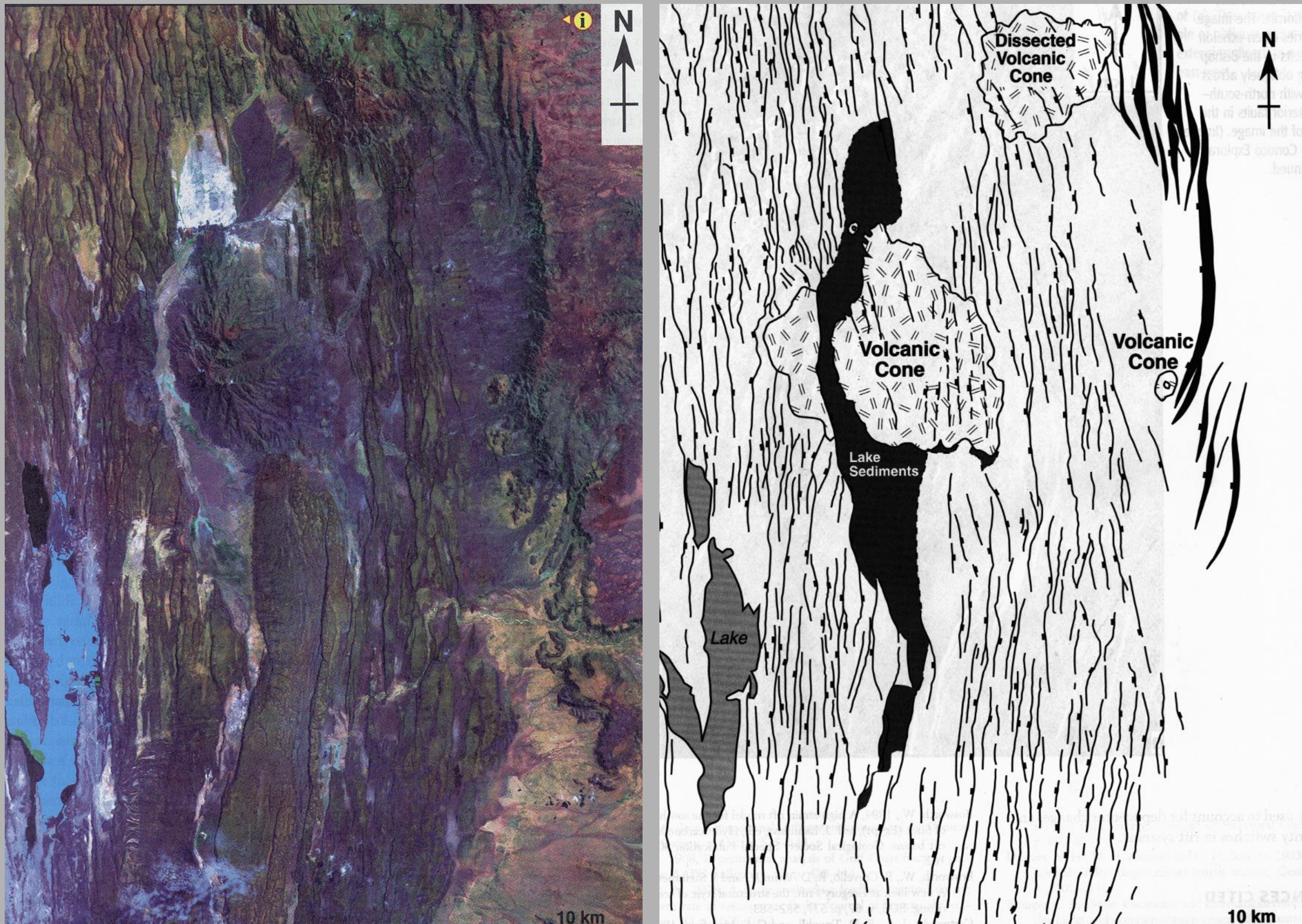
Riftové pánve jsou tvořeny jednou nebo více příkopovými strukturami (depocentry) vymezenými poklesovými zlomy (sklon 45 - 70°) a často doprovázenými množstvím strike-slipových zlomů.

Geometrie depocenter, povaha (pokles/strike-slip) a uspořádání zlomů závisí na orientaci vektoru extenze a osy riftu.



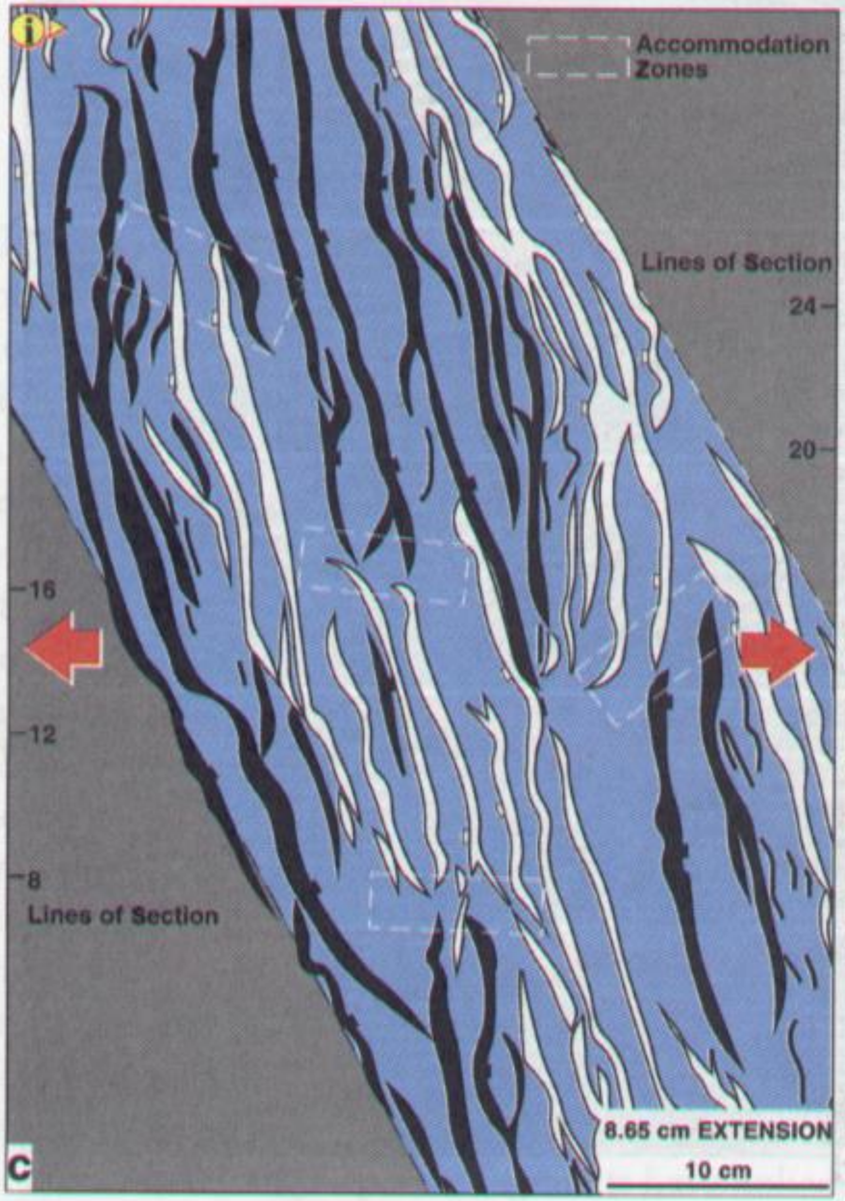
4.0 cm EXTENSION
a
10 cm
7.5 cm EXTENSION
b
10 cm

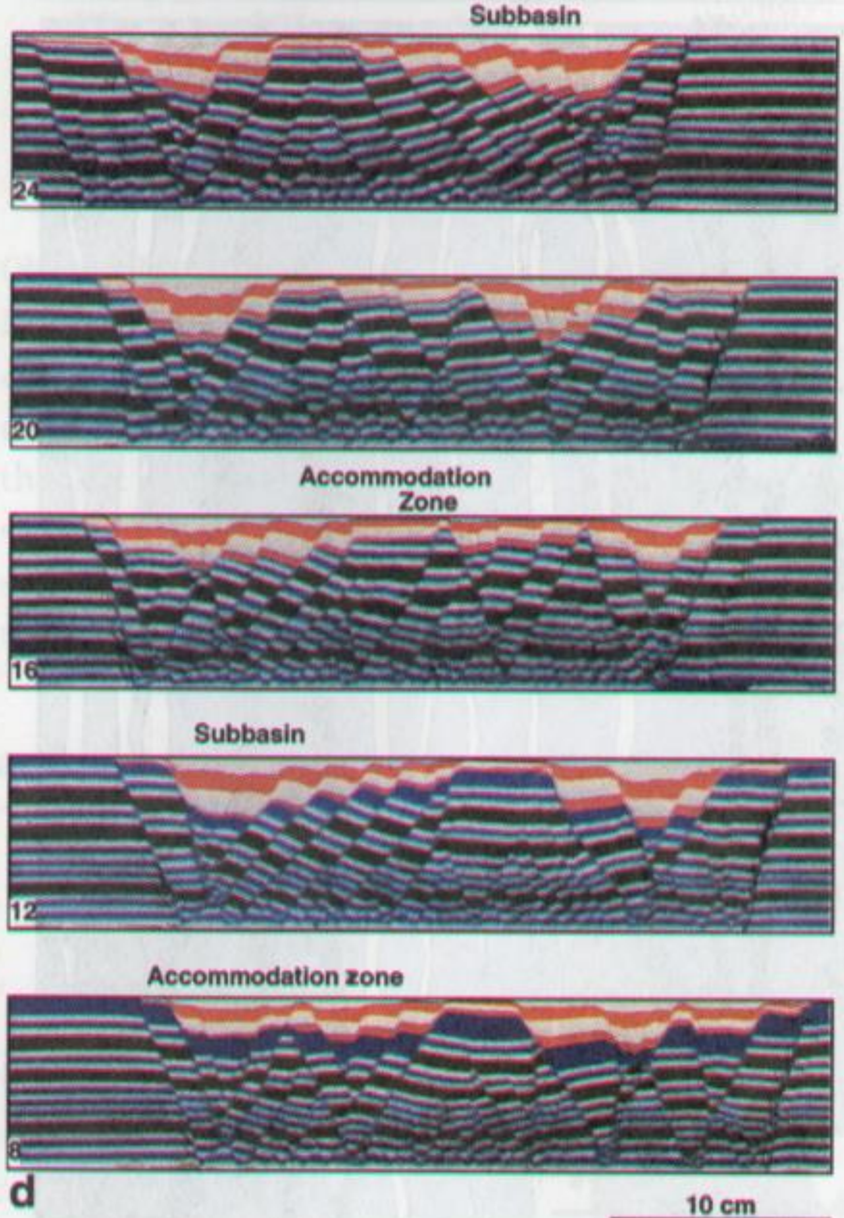

Lines of Section
24
20
16
12
8
7.5 cm EXTENSION
c
10 cm
24
20
16
12
8
d
10 cm

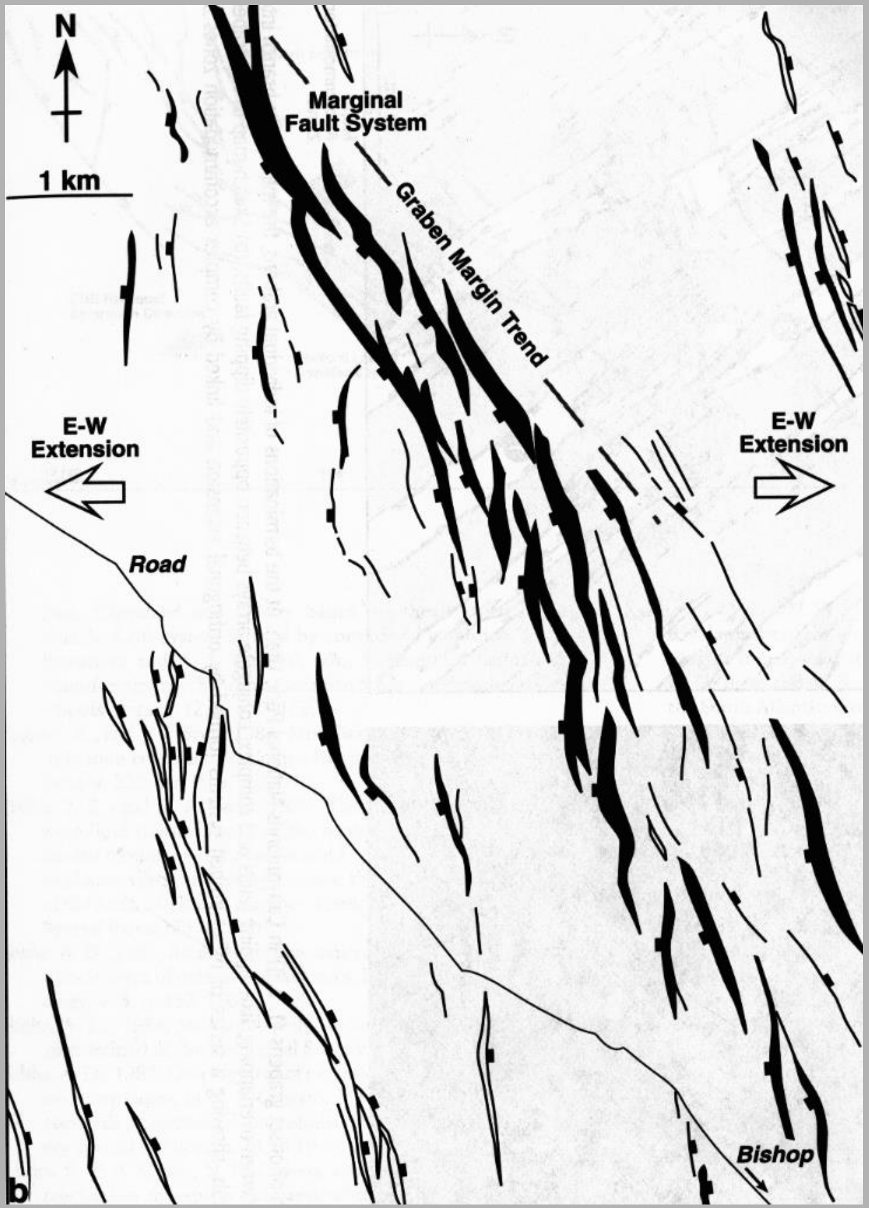


Gregory Rift, west of Nairobi, Kenya; McClay et al., 2002

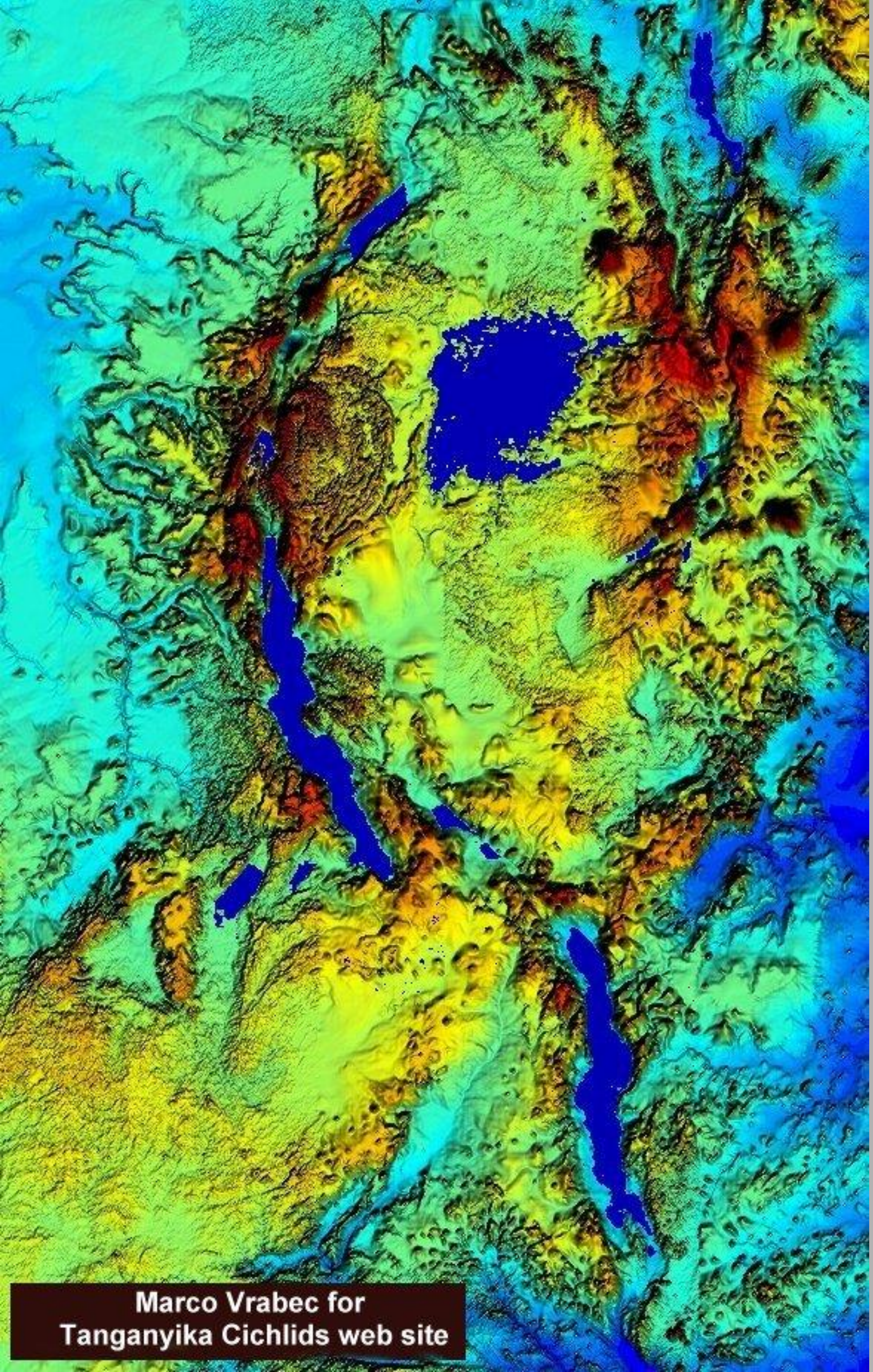

4.0 cm EXTENSION
a
10 cm
8.65 cm EXTENSION
b
10 cm


Accommodation Zones
Lines of Section
24
20
16
12
8
Lines of Section
8.65 cm EXTENSION
10 cm
c

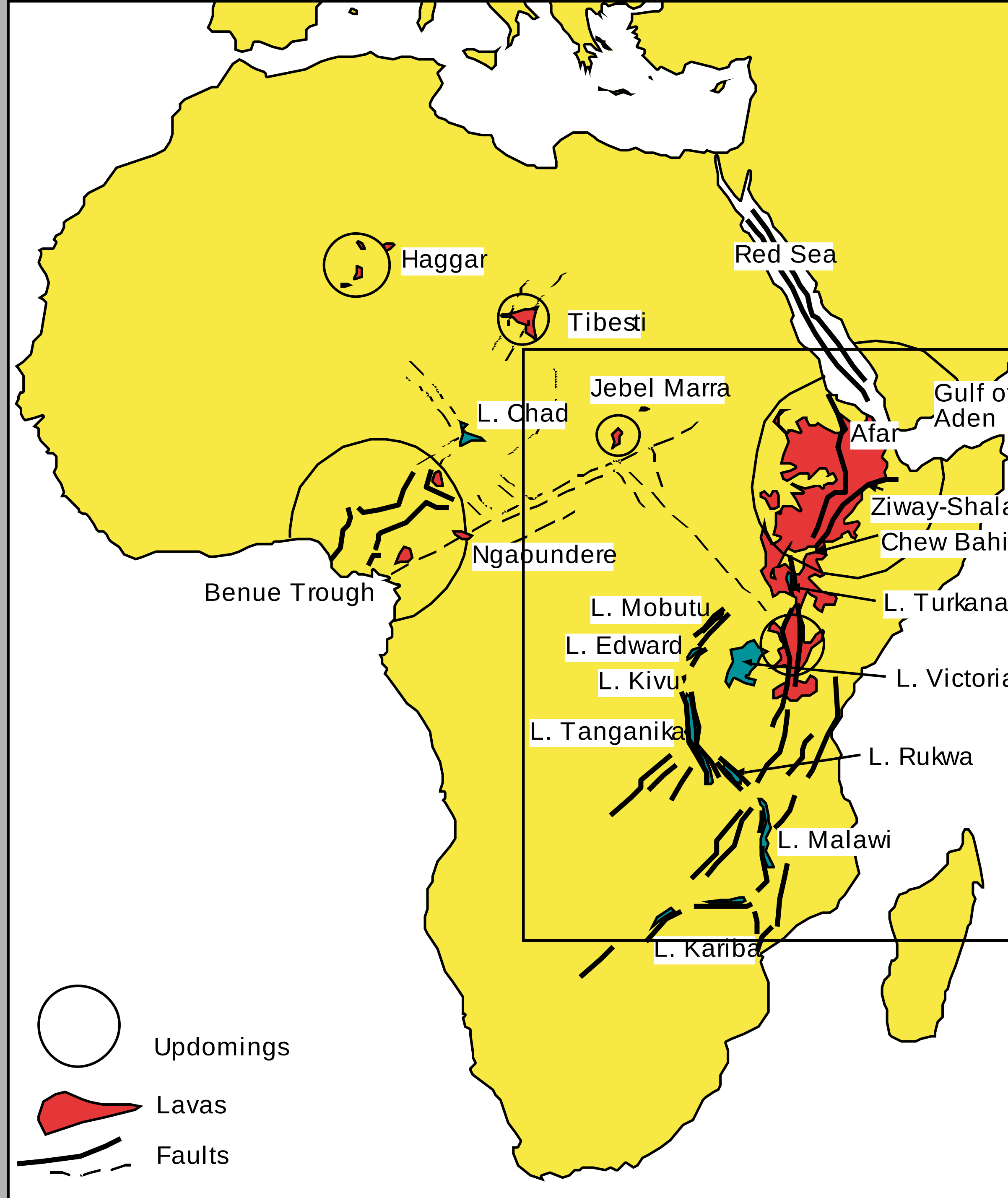

Subbasin
24
20
Accommodation Zone
16
Subbasin
12
Accommodation zone
8
d
10 cm

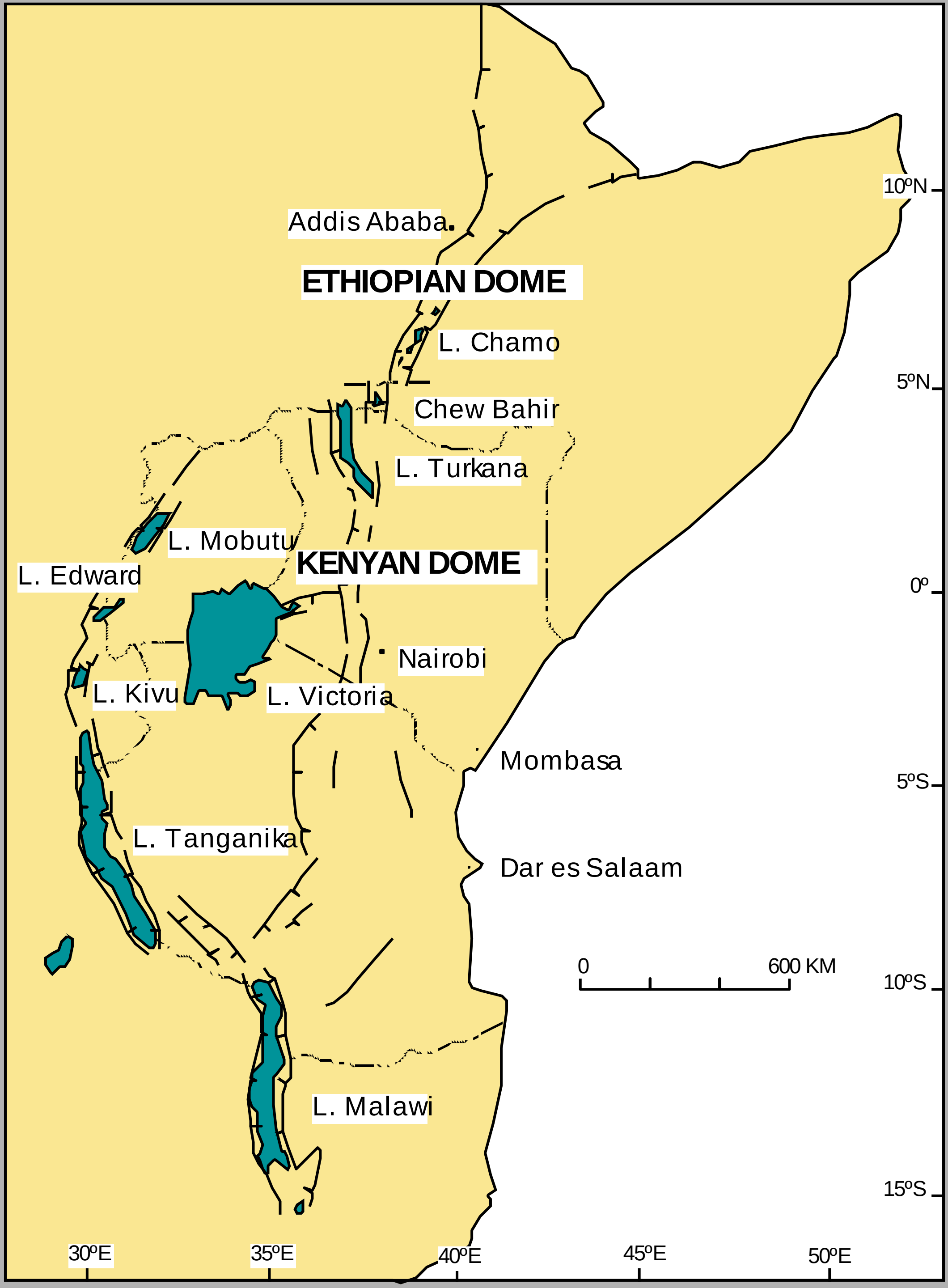


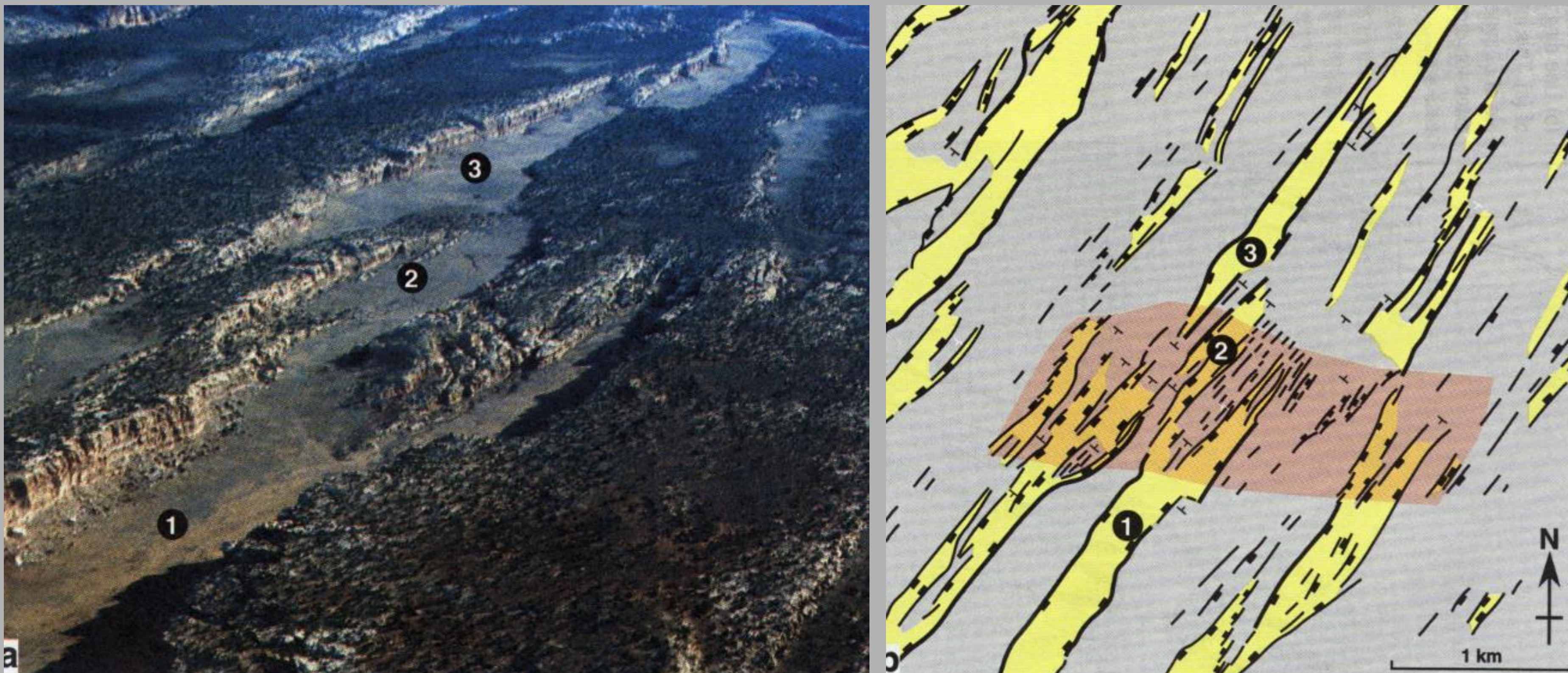
Volcanic tablelands, Bishop, California; McClay et al., 2002


Marco Vrabec for
Tanganyika Cichlids web site

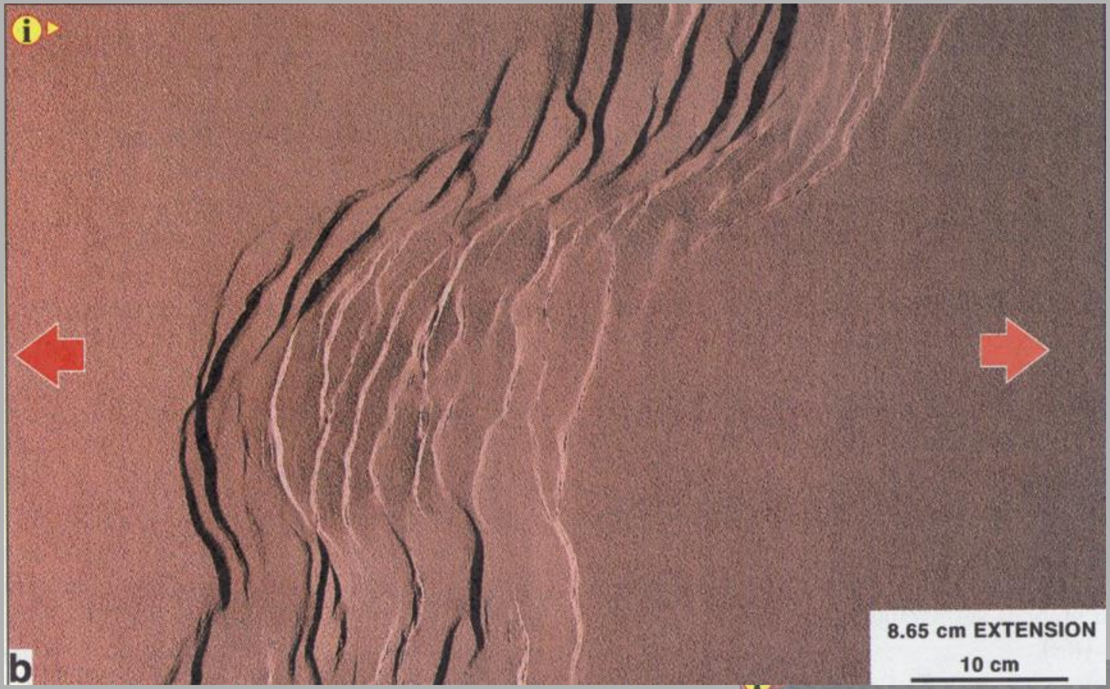

Marco Vrabec for
Tanganyika Cichlids web site


Haggar
Tibesti
Red Sea
Jebel Marra
L. Chad
Gulf of
Aden
Afar
Ziway-Shala
Chew Bahir
Ngaoundere
Benue Trough
L. Mobutu
L. Edward
L. Kivu
L. Turkana
L. Victoria
L. Tanganika
L. Rukwa
L. Malawi
L. Kariba
Updomings
Lavas
Faults

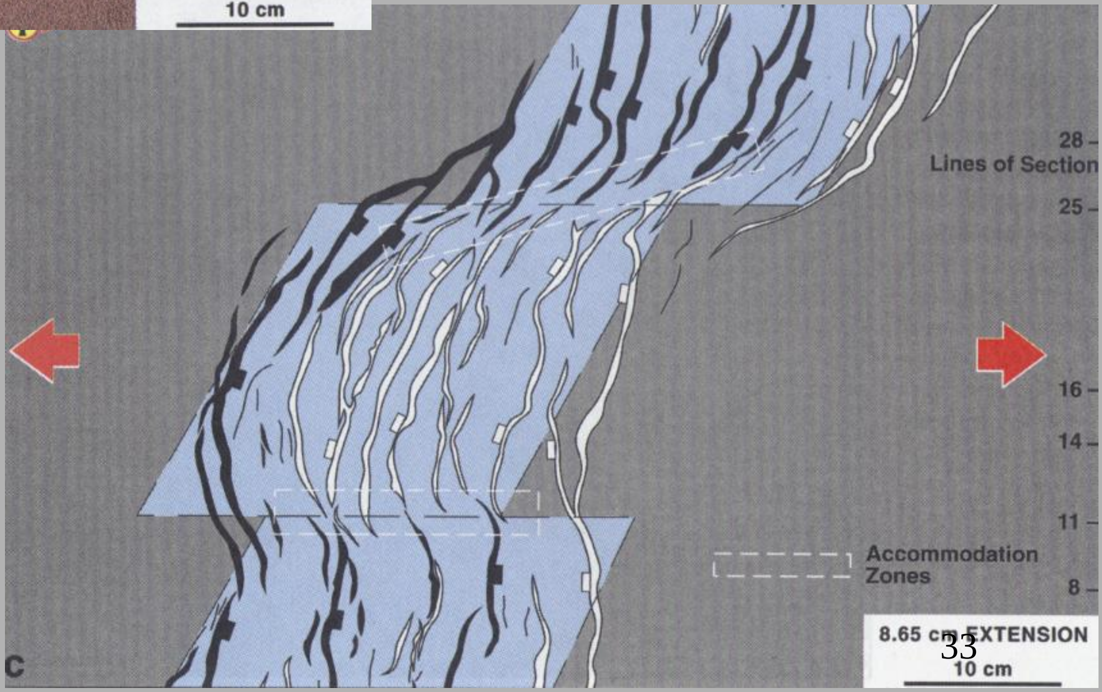

Addis Ababa
ETHIOPIAN DOME
L. Chamo
Chew Bahir
L. Turkana
L. Mobutu
KENYAN DOME
L. Edward
Nairobi
L. Kivu
L. Victoria
Mombasa
L. Tanganika
Dar es Salaam
L. Malawi
0
600 KM
10ºN
5ºN
0º
5ºS
10ºS
15ºS
30ºE
35ºE
40ºE
45ºE
50ºE



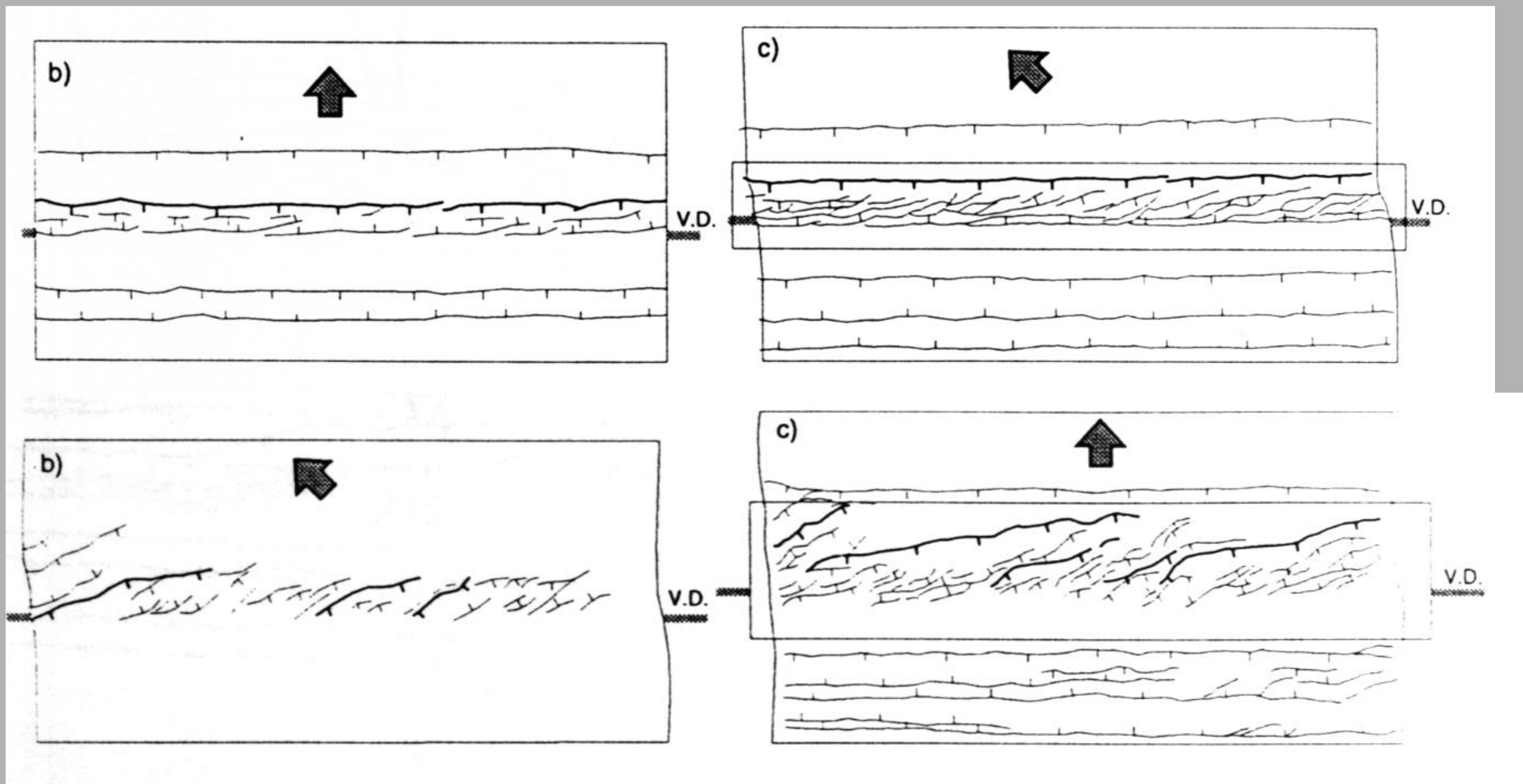
Canyonlands National Park, Utah; McClay et al., 2002



8.65 cm EXTENSION
10 cm
b



28
Lines of Section
25
16
14
11
8
Accommodation Zones
8.65 cm EXTENSION
10 cm
c


b)
V.D.
c)
V.D.
b)
V.D.
c)
V.D.

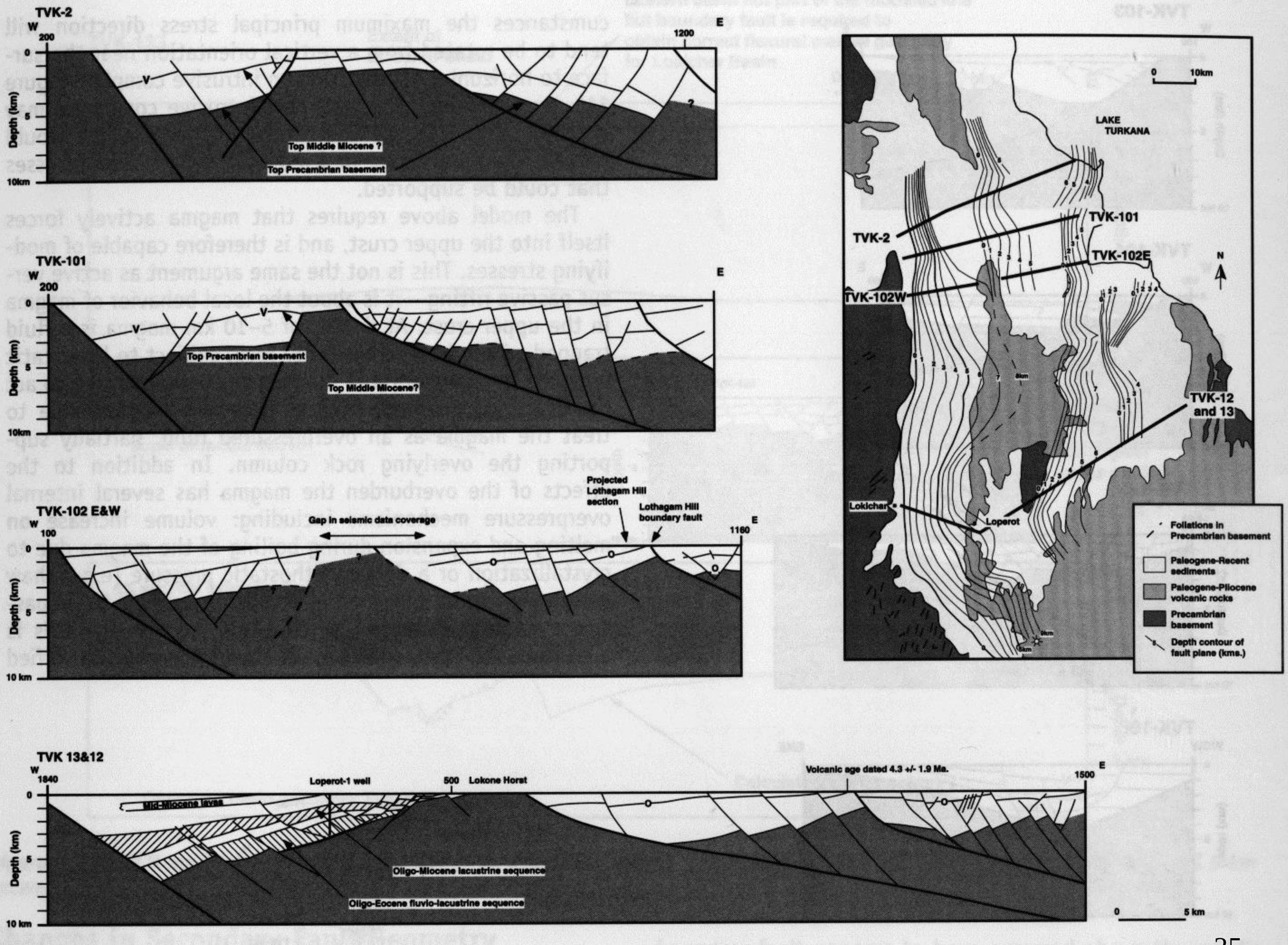
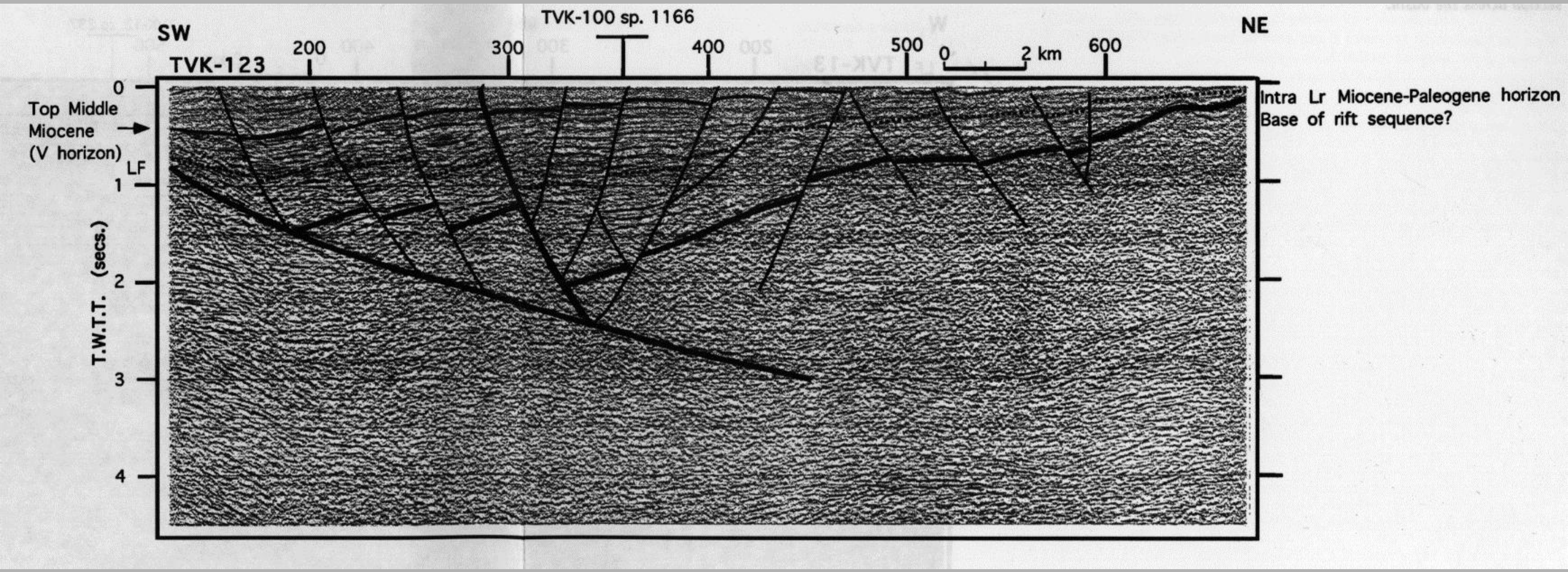
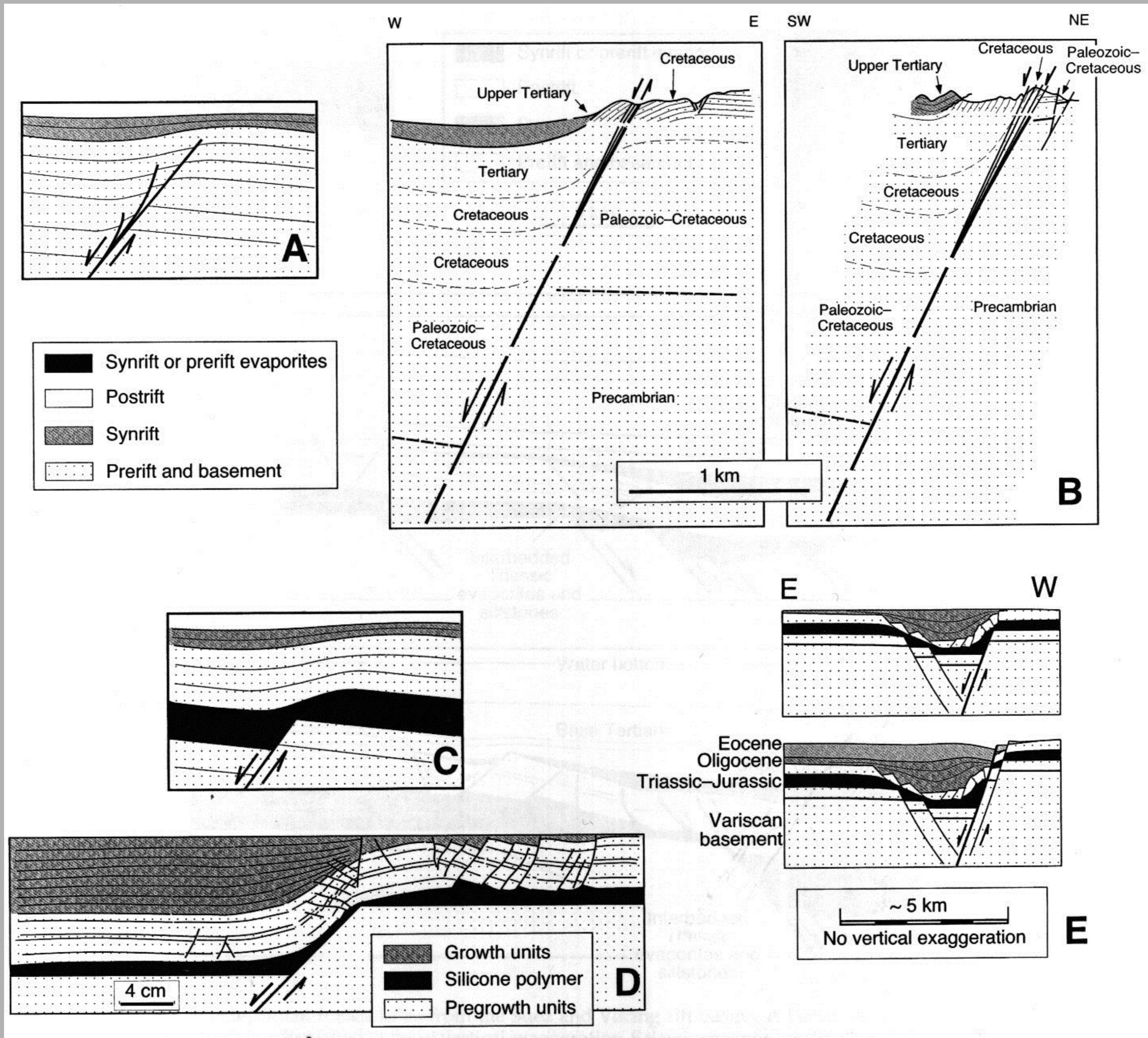


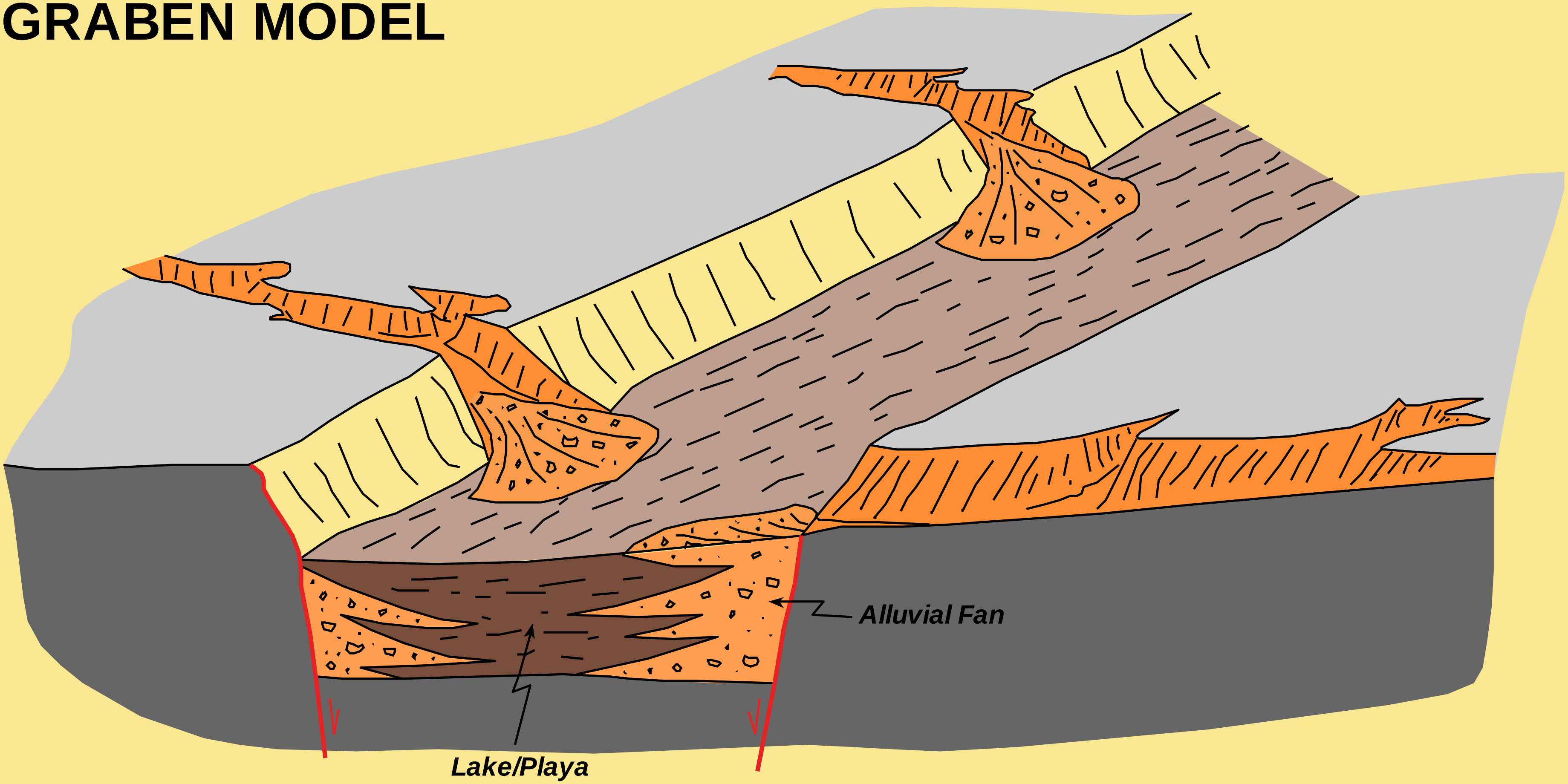
Figure 10. Regional cross sections though the Turkana area based on seismic reflection data.


SW
TVK-123
TVK-100 sp. 1166
NE
200
300
400
500
600
0
2 km
Top Middle
Miocene
(V horizon)
LF
Intra Lr Miocene-Paleogene horizon
Base of rift sequence?
T.W.T.T. (secs.)
0
1
2
3
4

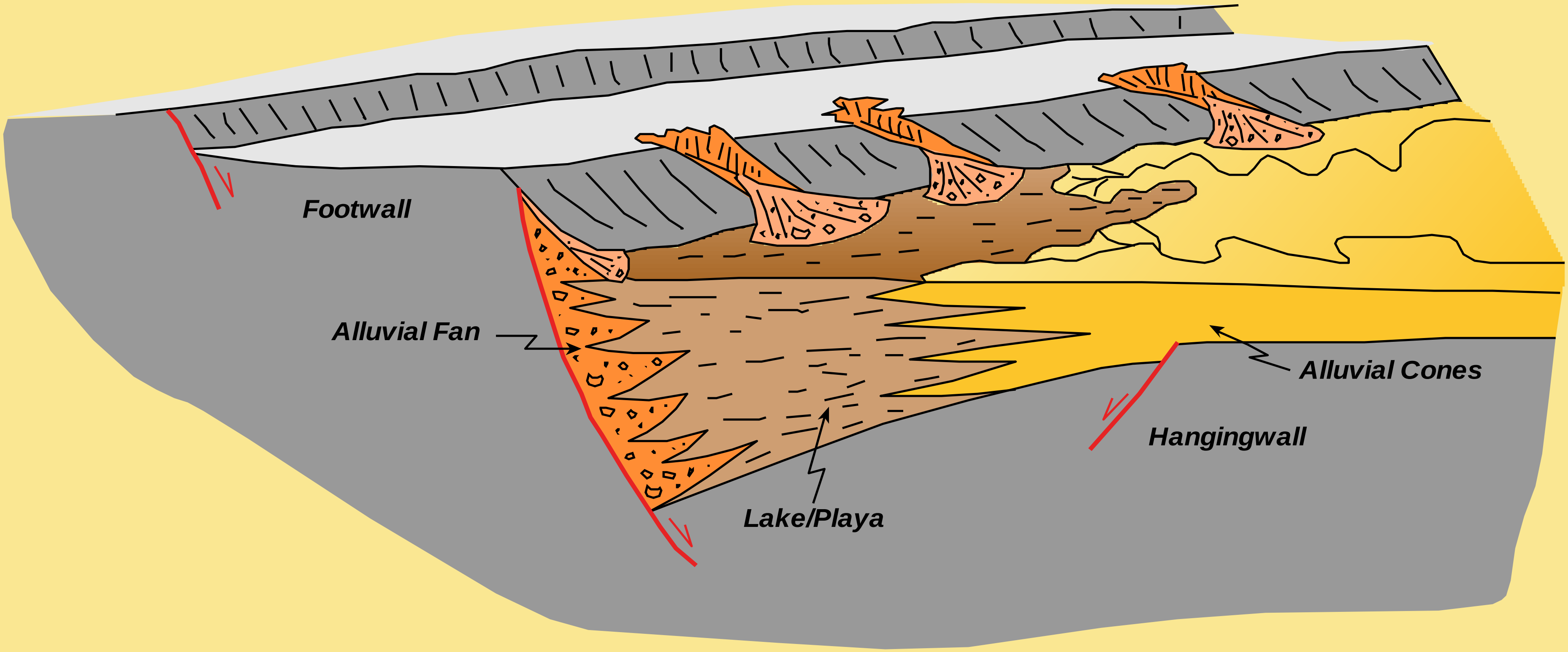
růstové zlomy



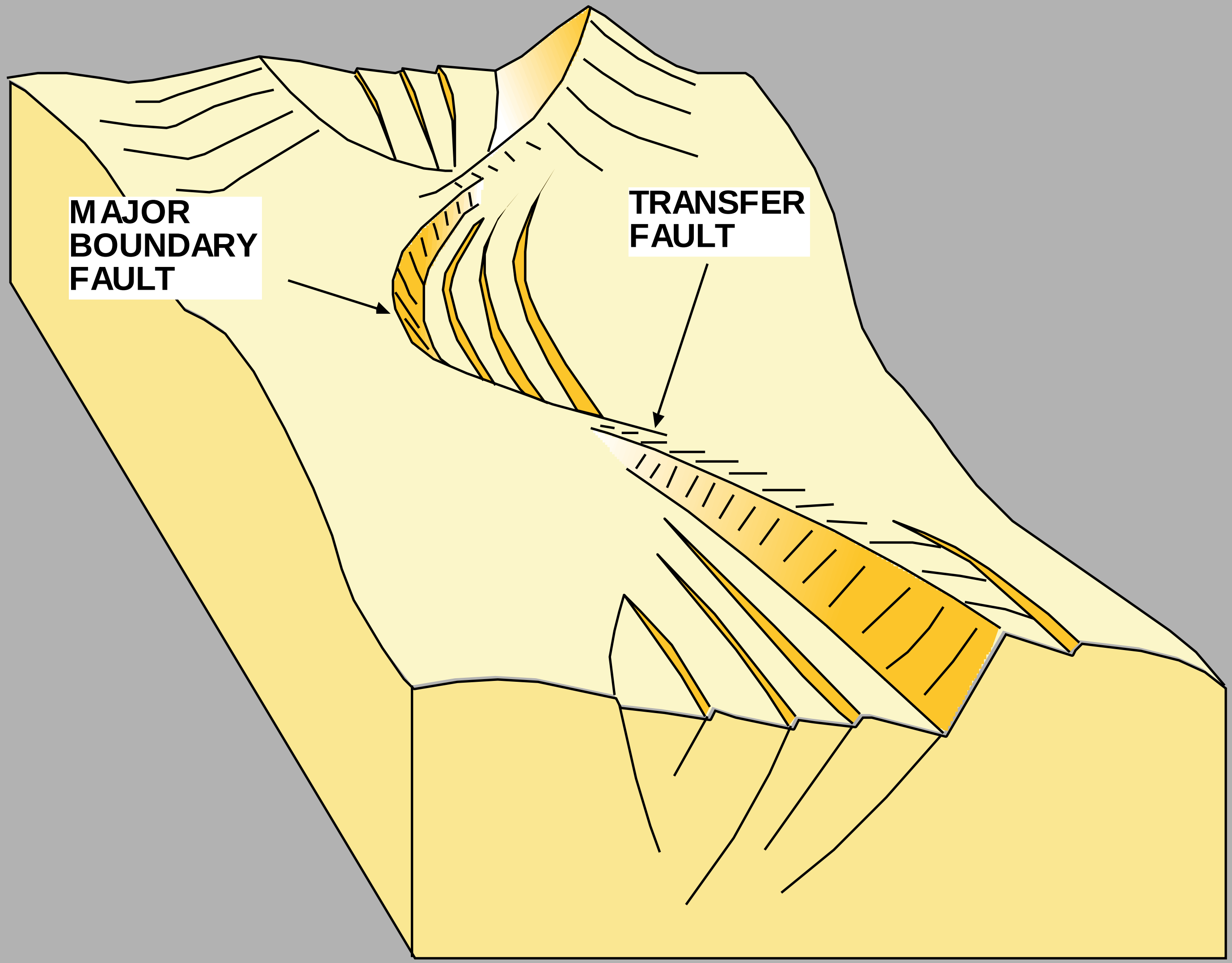
GRABEN MODEL



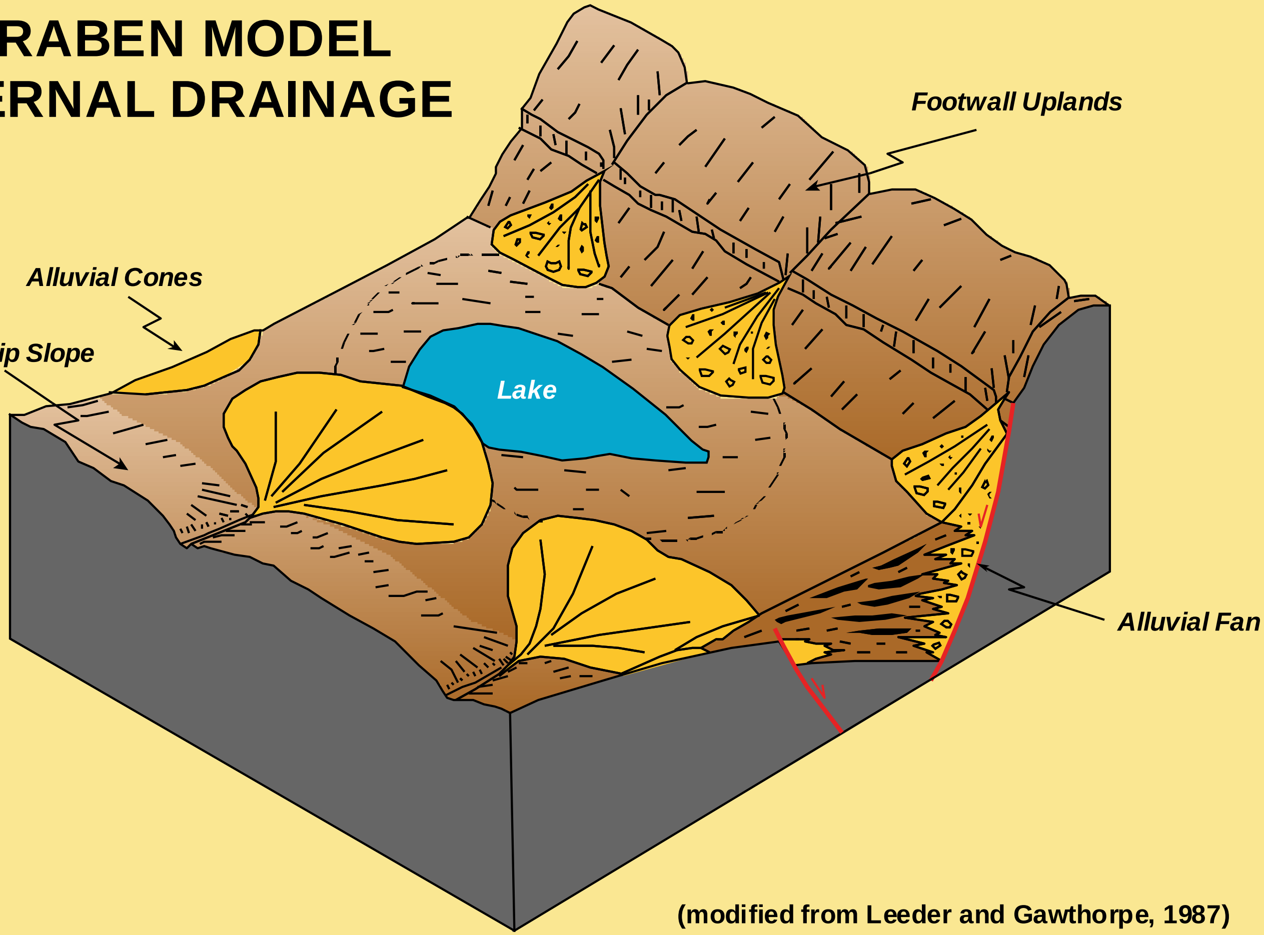
HALF GRABEN MODEL



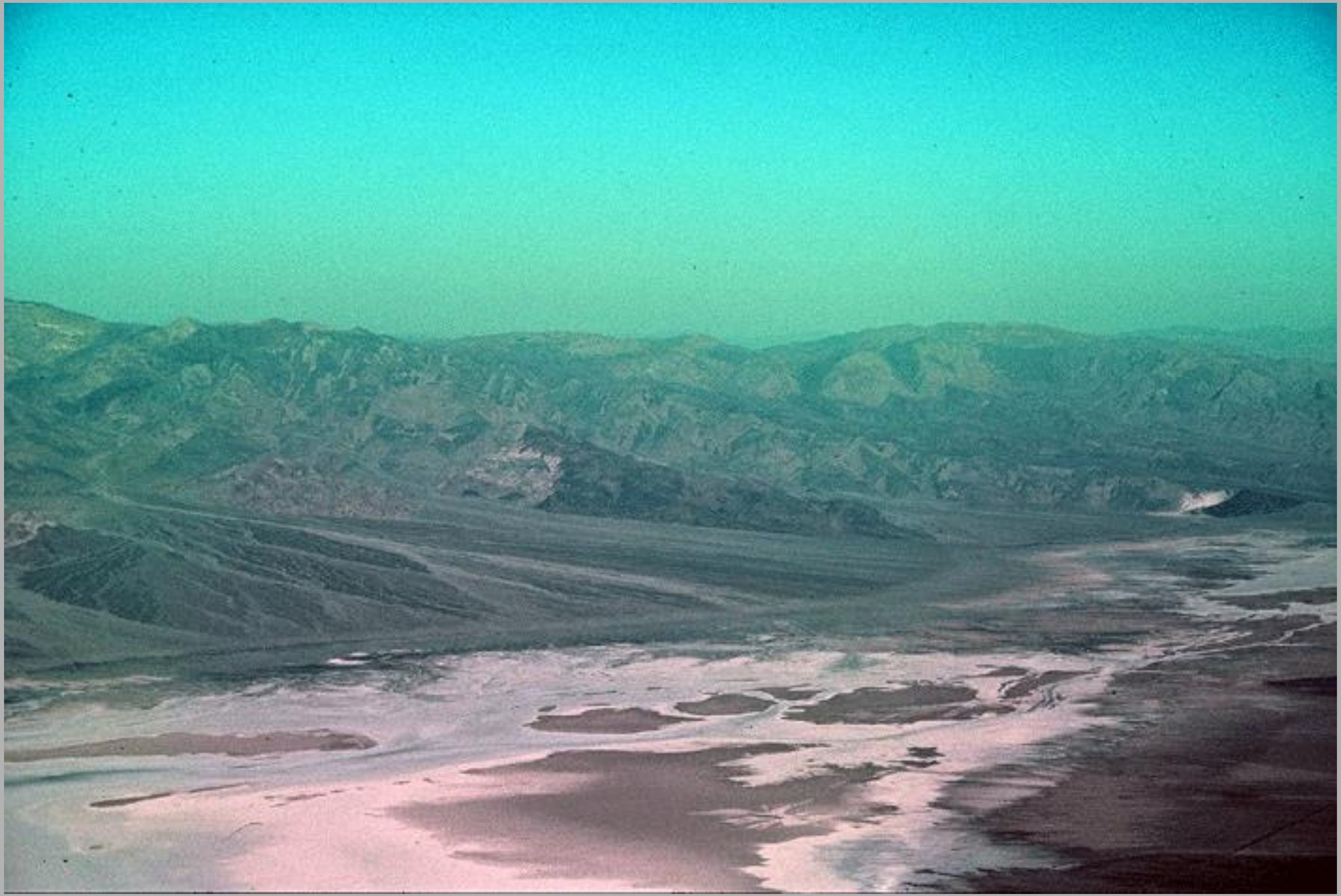
(modified from Forstick and Reid, 1981)


MAJOR
BOUNDARY
FAULT
TRANSFER
FAULT

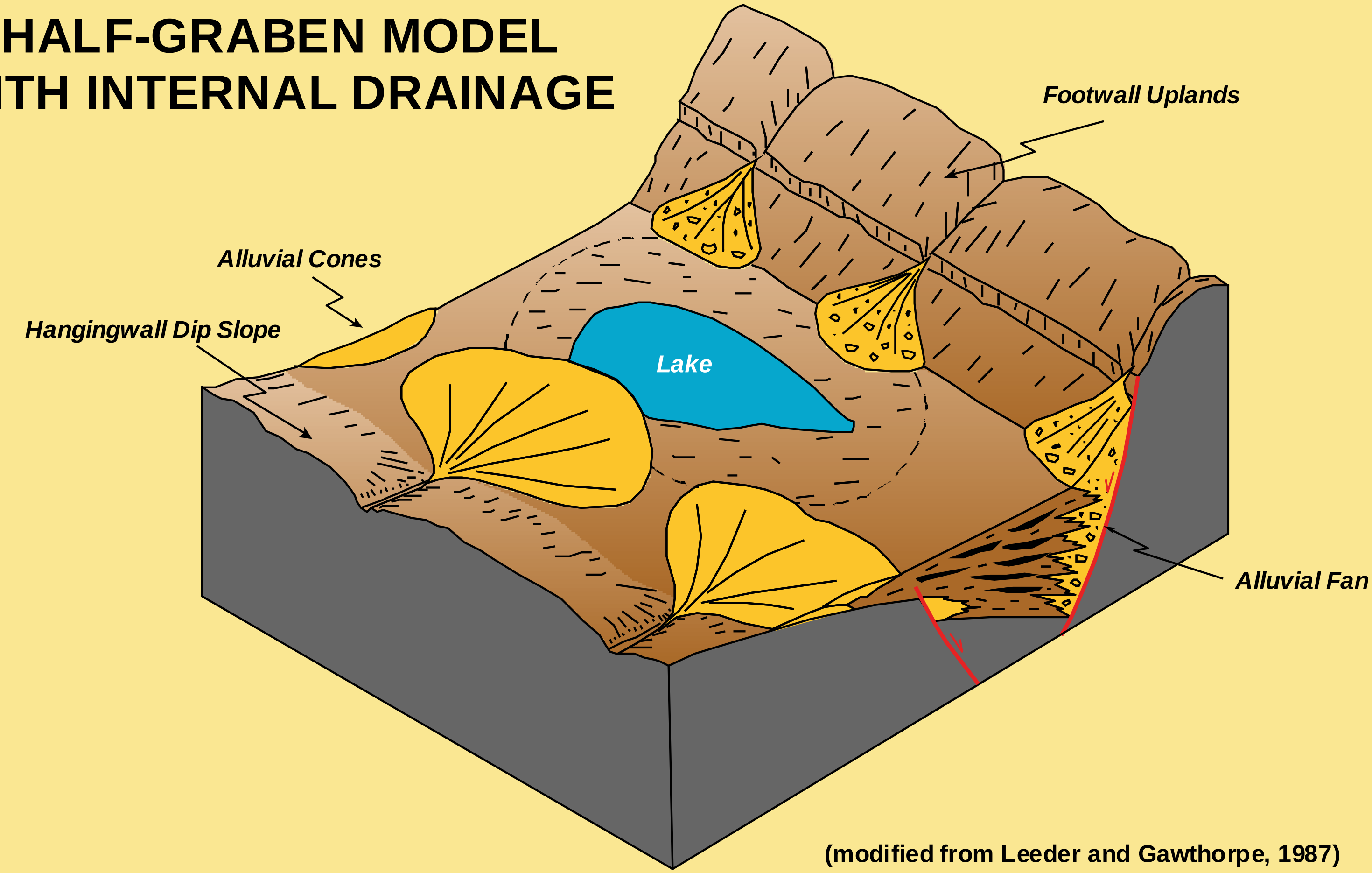
CONTINENTAL HALF-GRABEN MODEL WITH INTERNAL DRAINAGE



(modified from Leeder and Gawthorpe, 1987)

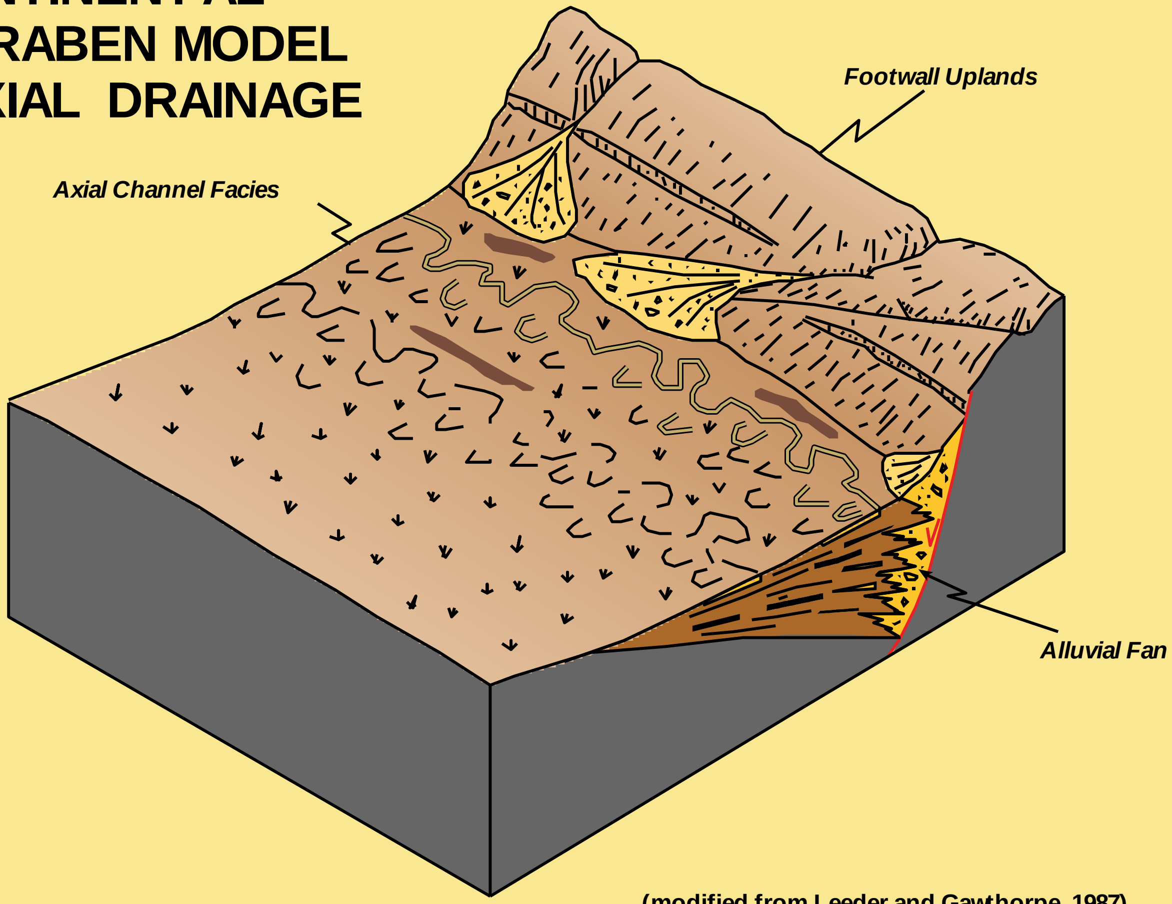


CONTINENTAL HALF-GRABEN MODEL WITH INTERNAL DRAINAGE



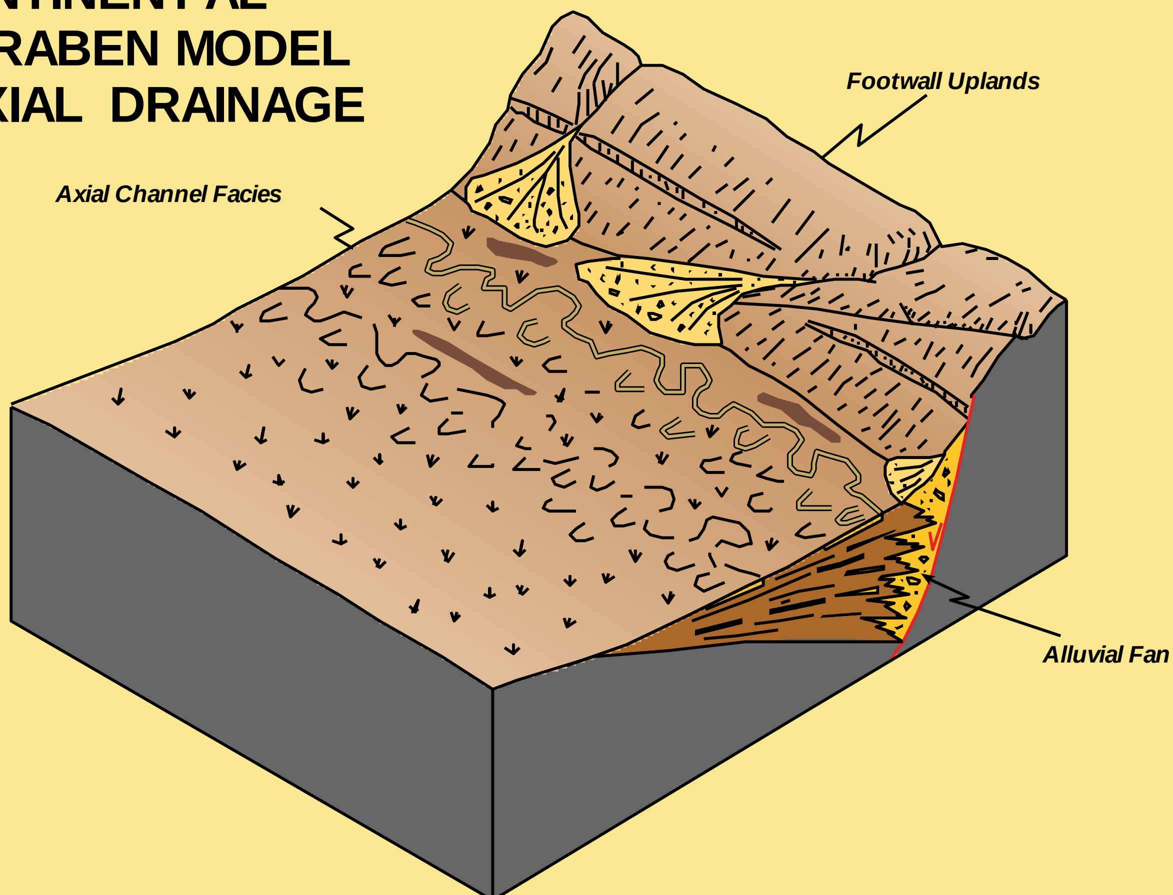
(modified from Leeder and Gawthorpe, 1987)

CONTINENTAL HALF-GRABEN MODEL WITH AXIAL DRAINAGE



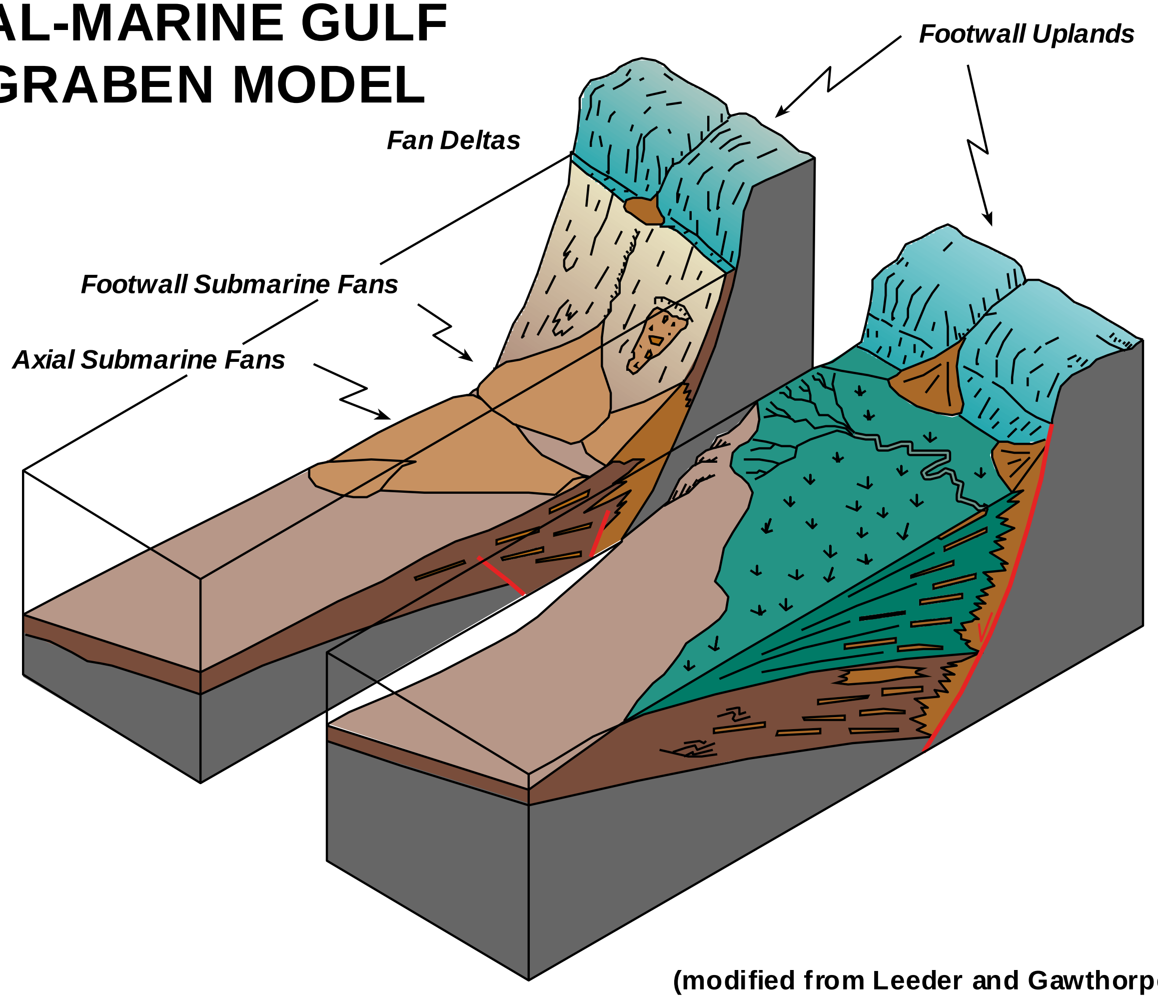
(modified from Leeder and Gawthorpe, 1987)

CONTINENTAL HALF-GRABEN MODEL WITH AXIAL DRAINAGE



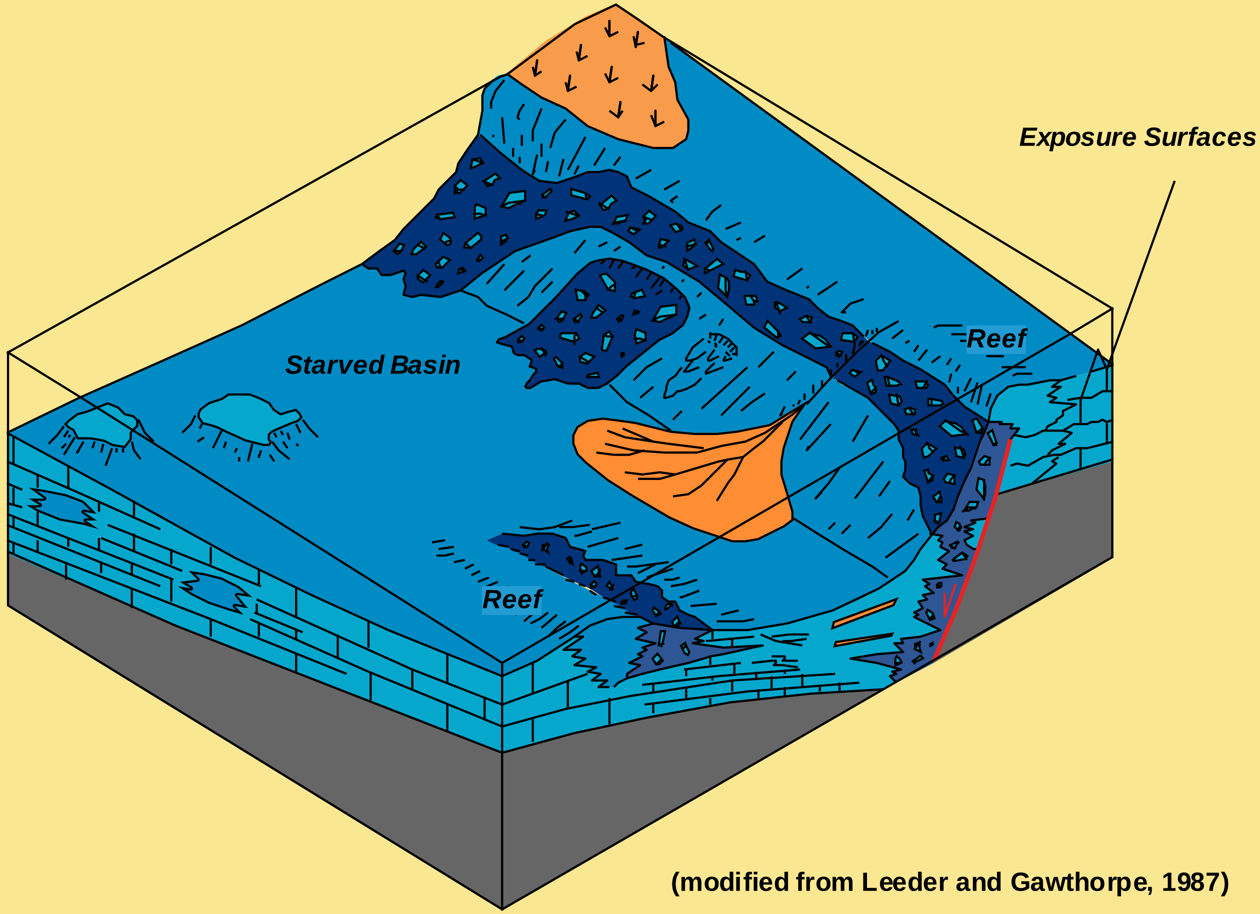
(modified from Leeder and Gawthorpe, 1987)

COASTAL-MARINE GULF HALF-GRABEN MODEL

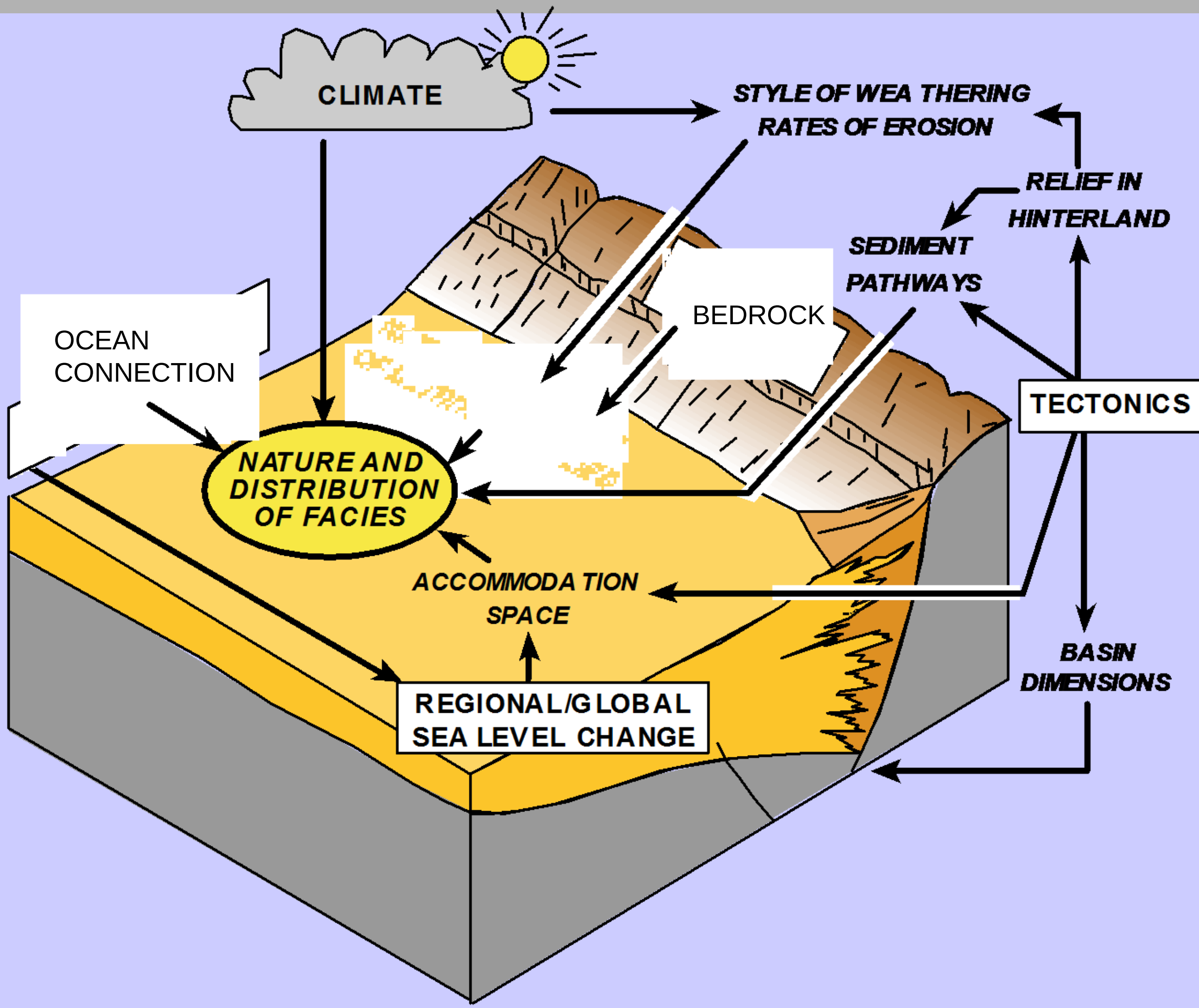


(modified from Leeder and Gawthorpe, 1987)

CARBONATE COASTAL/SHELF HALF-GRABEN MODEL

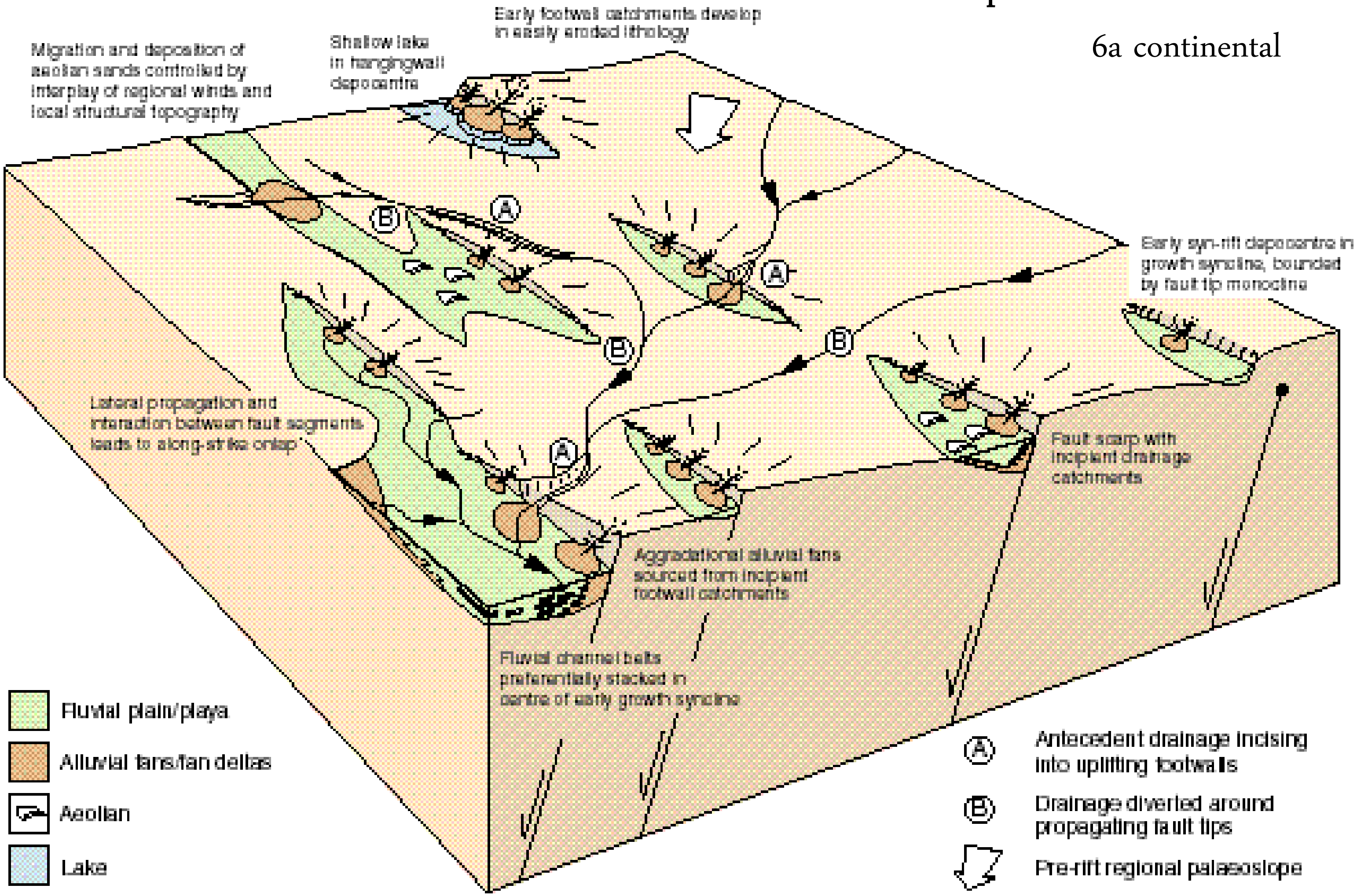


(modified from Leeder and Gawthorpe, 1987)


CLIMATE
STYLE OF WEA THERING
RATES OF EROSION
RELIEF IN
HINTERLAND
SEDIMENT
PATHWAYS
BEDROCK
OCEAN
CONNECTION
TECTONICS
NATURE AND
DISTRIBUTION
OF FACIES
ACCOMMODA TION
SPACE
BASIN
DIMENSIONS
REGIONAL/GLOBAL
SEA LEVEL CHANGE

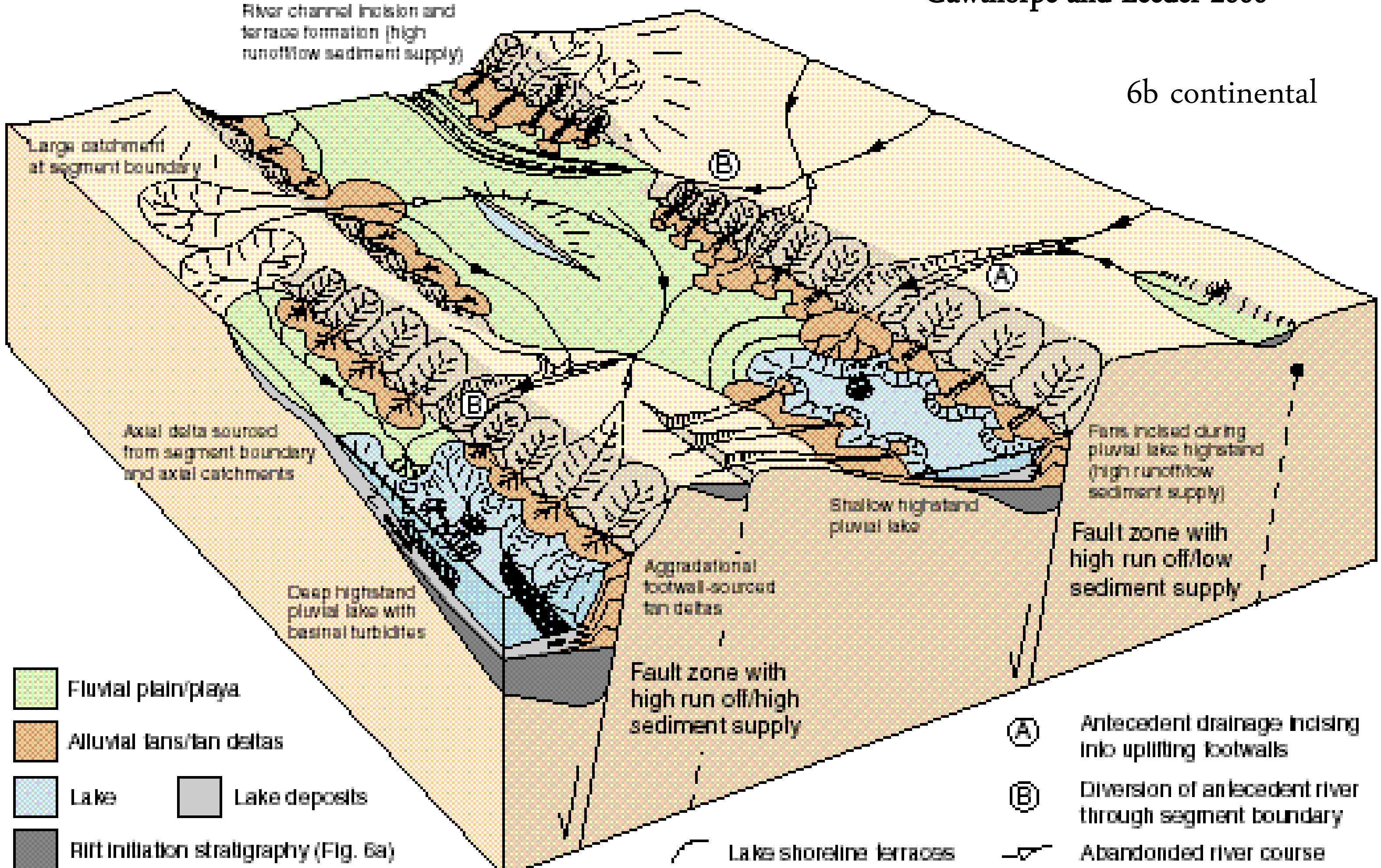
Gawthorpe and Leeder 2000

6a continental



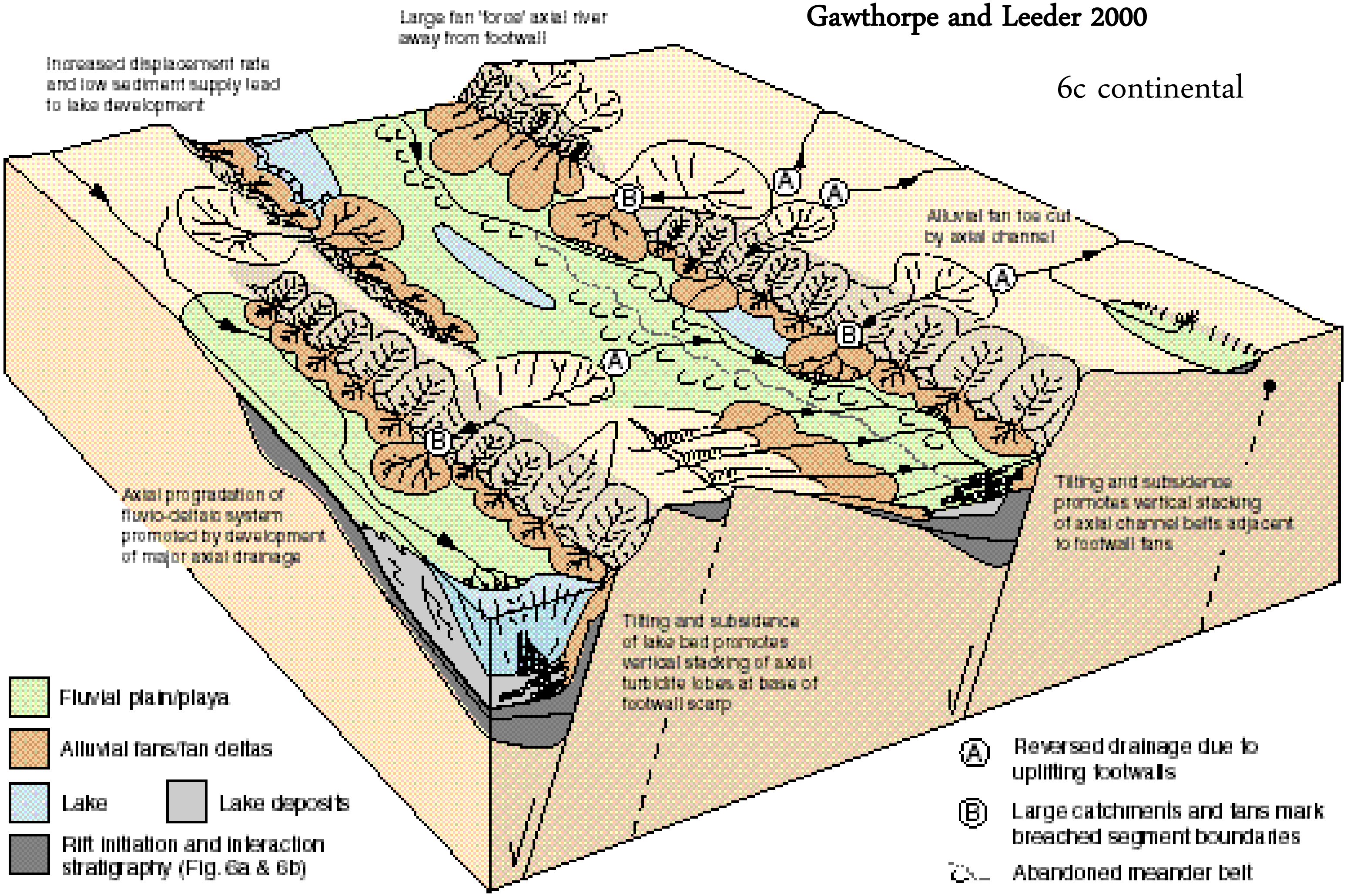
Gawthorpe and Leeder 2000

6b continental



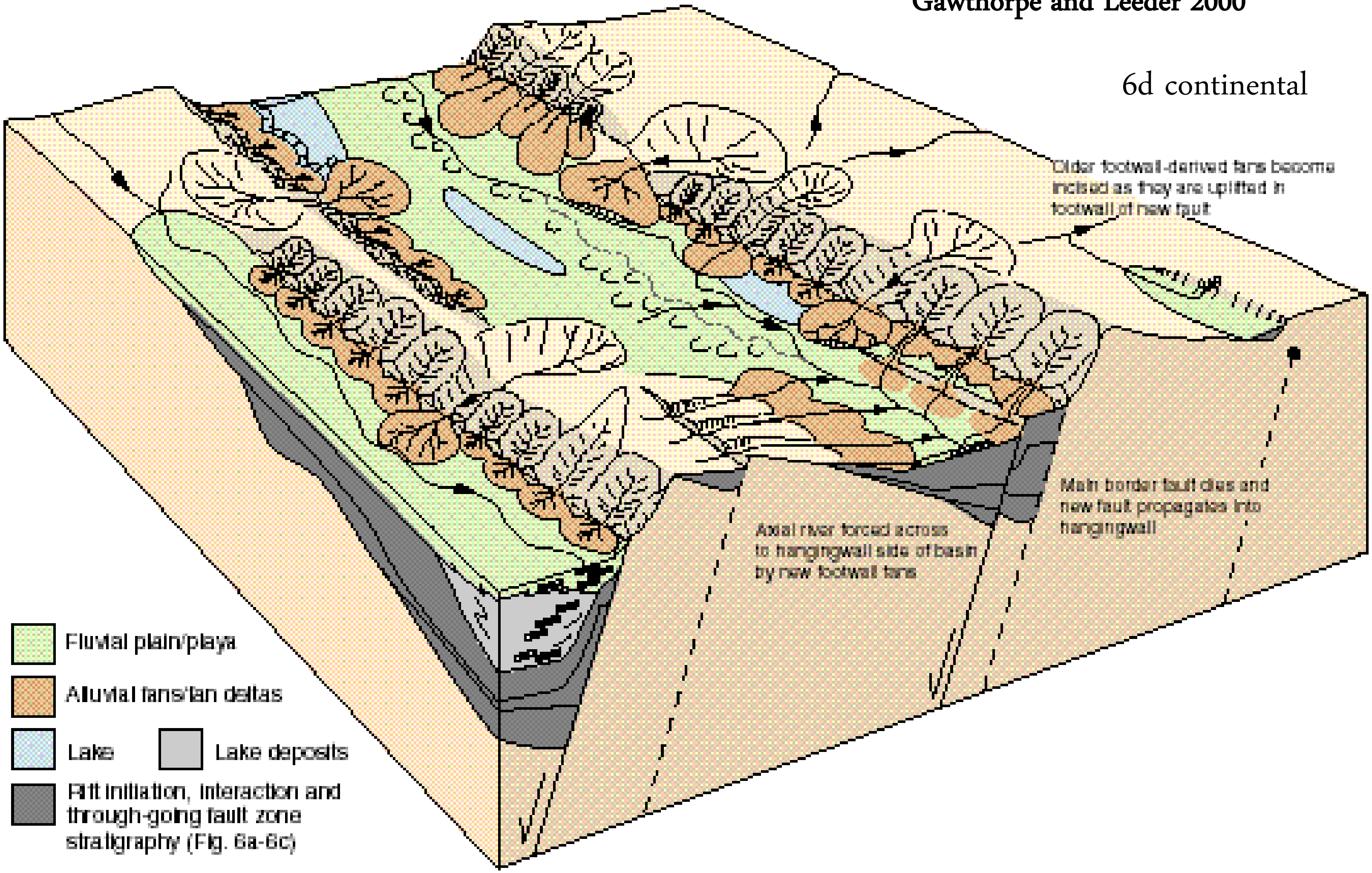
Gawthorpe and Leeder 2000

6c continental



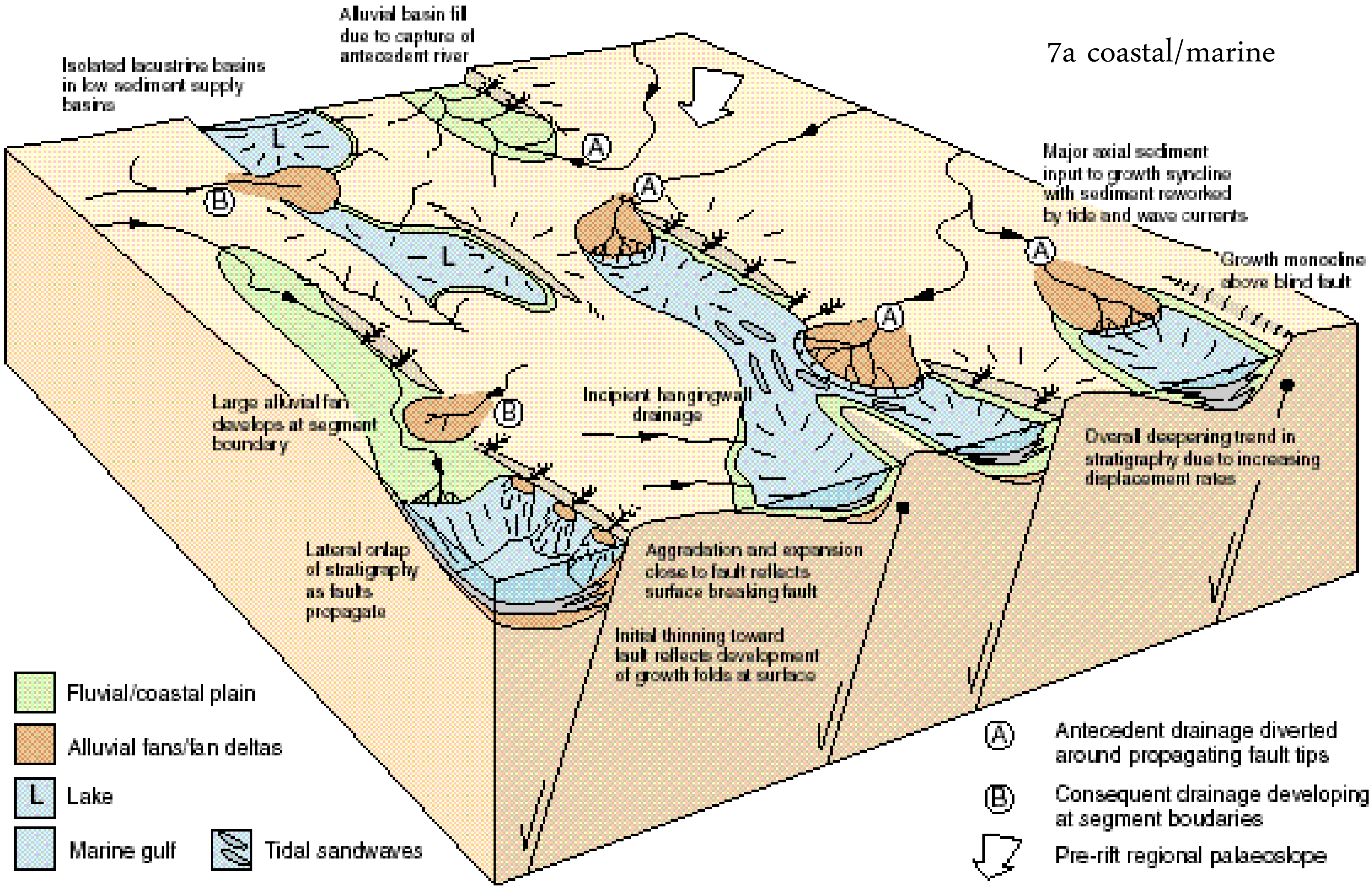
Gawthorpe and Leeder 2000

6d continental



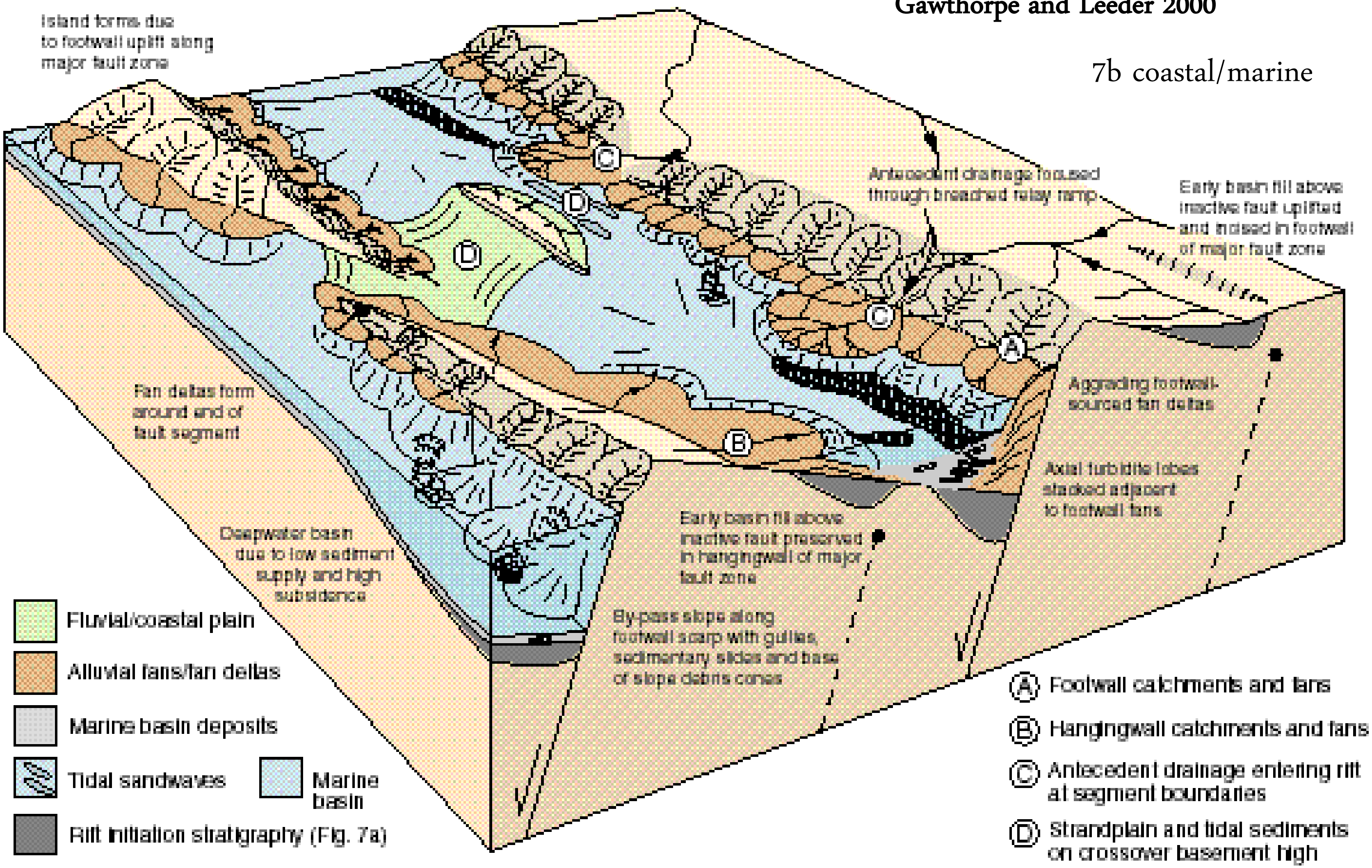
Gawthorpe and Leeder 2000

7a coastal/marine



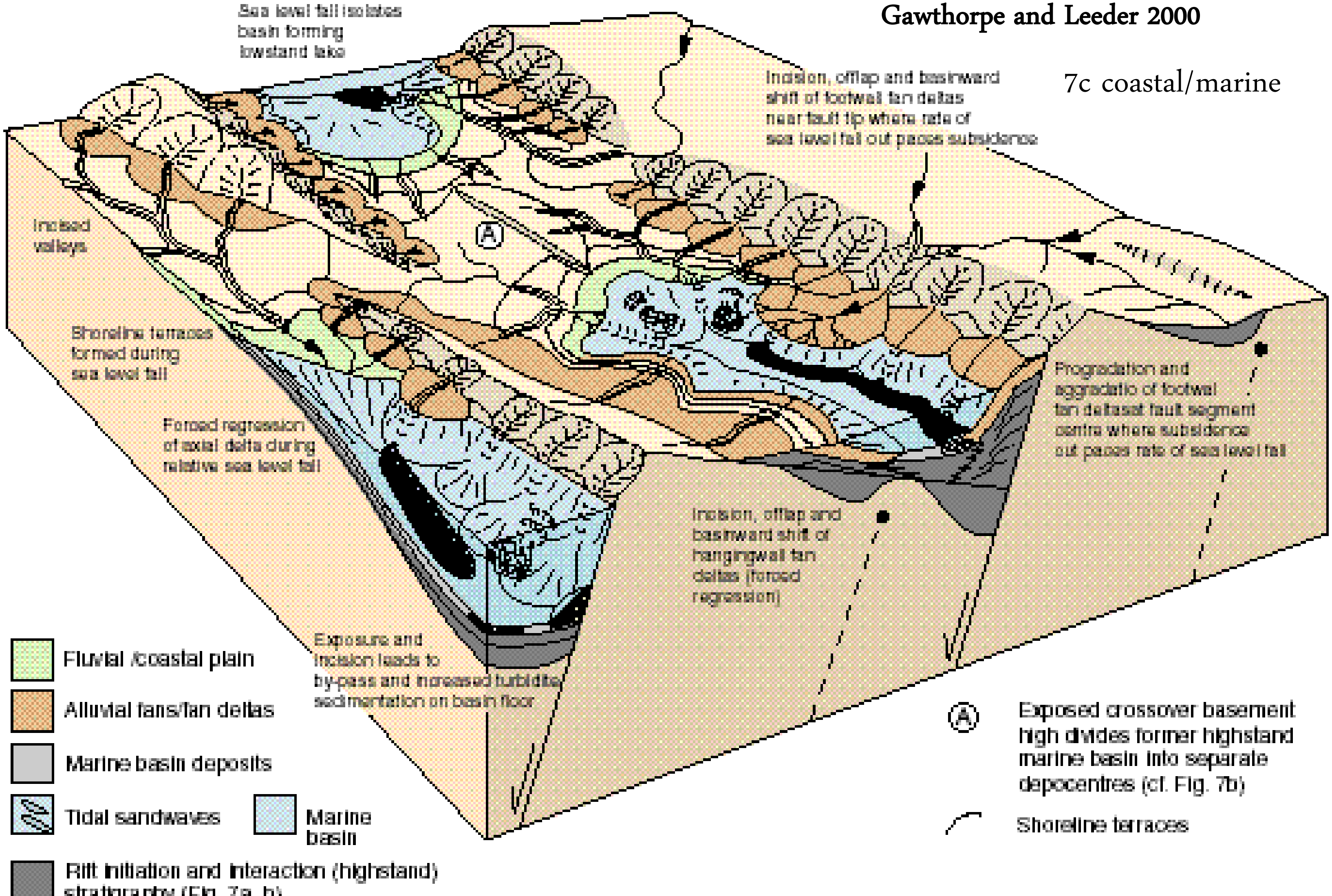
Gawthorpe and Leeder 2000

7b coastal/marine



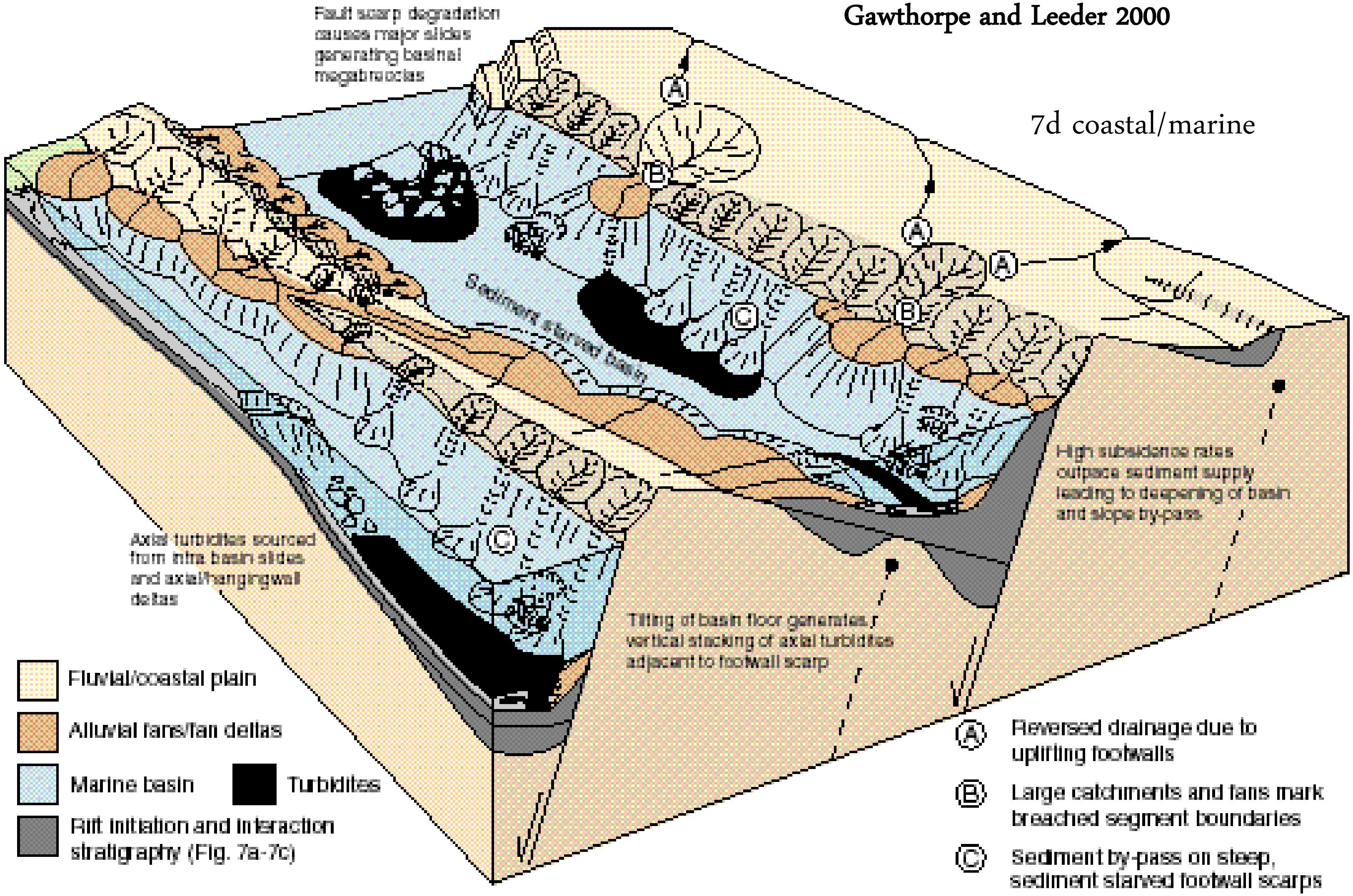
Gawthorpe and Leeder 2000

7c coastal/marine

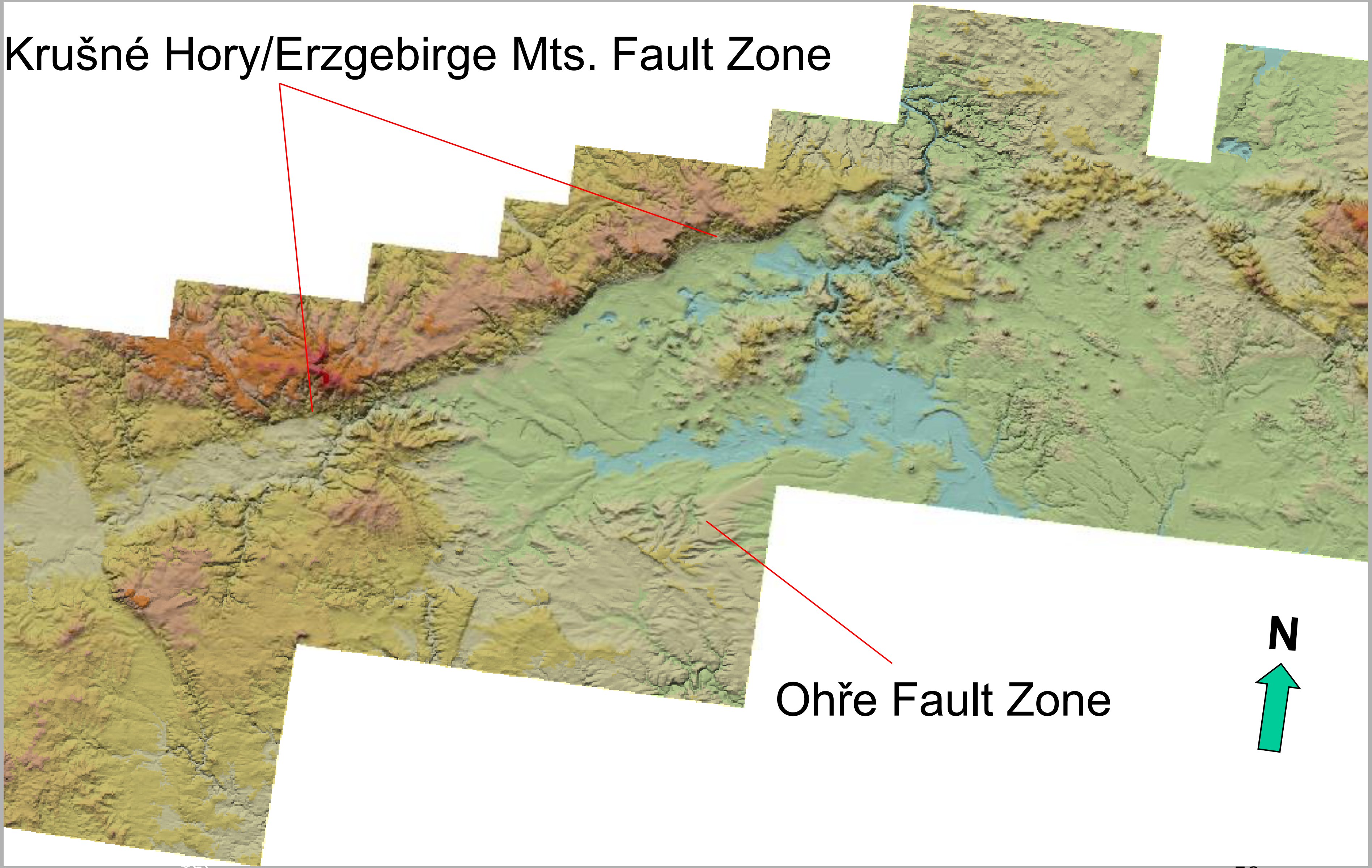


Gawthorpe and Leeder 2000

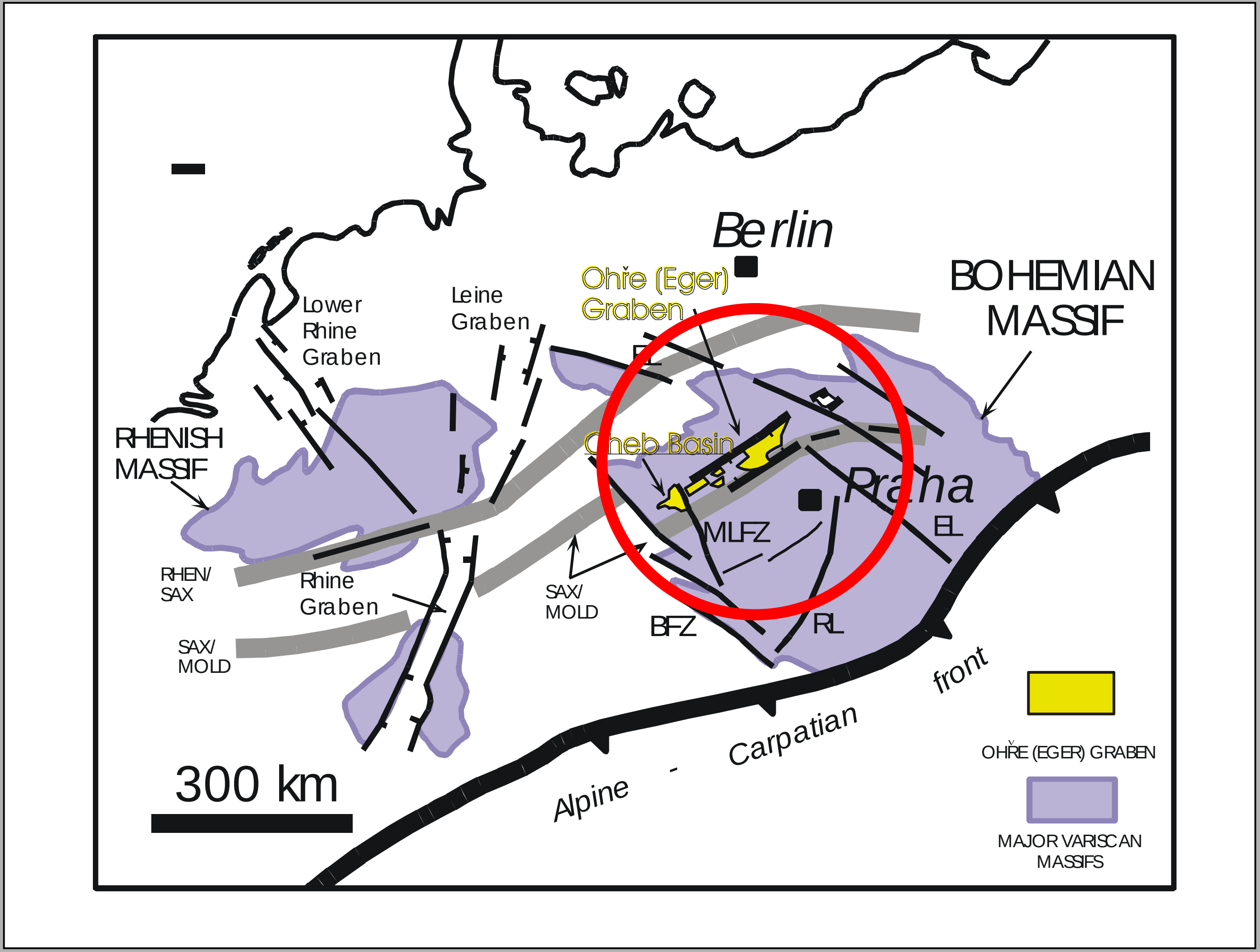
7d coastal/marine



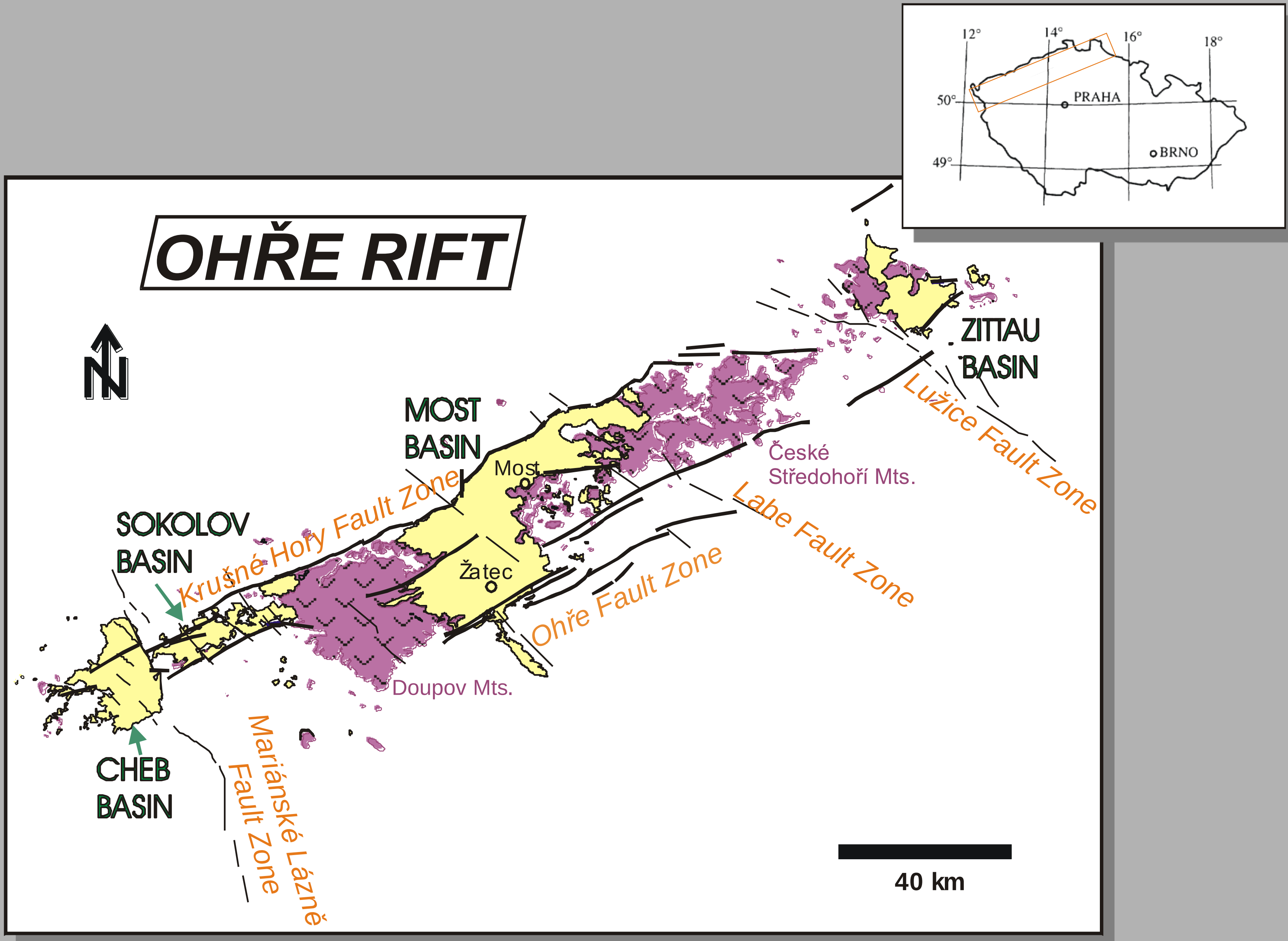
SW-NE – trending structures prominent in Recent topography

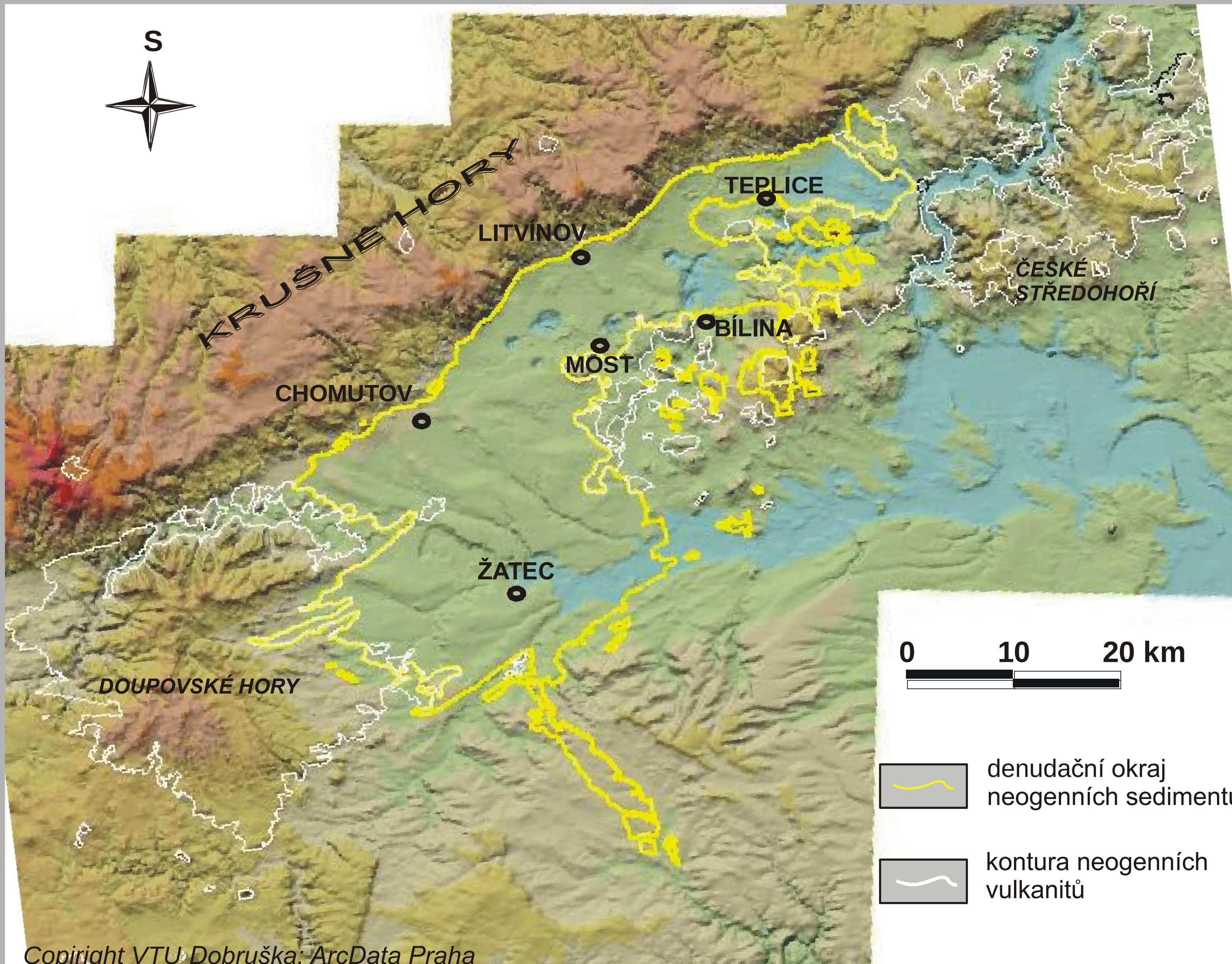


Eger Rift - part of the European Cenozoic rift system:

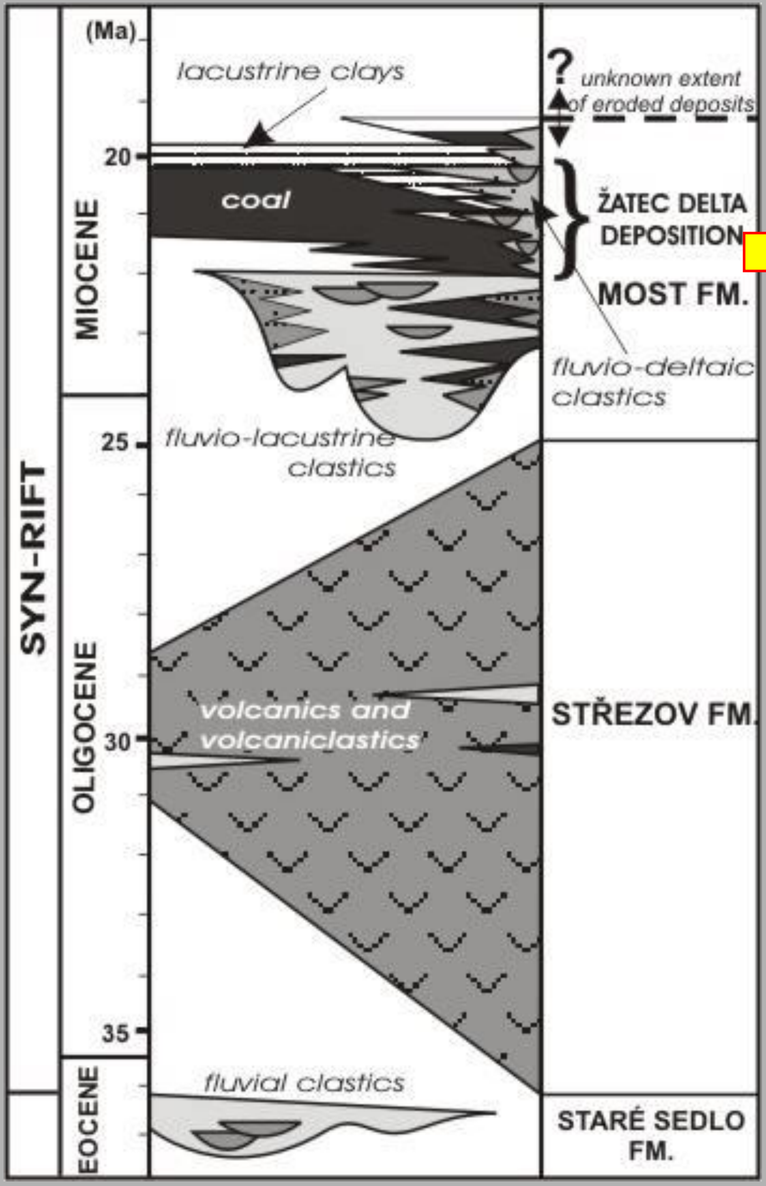


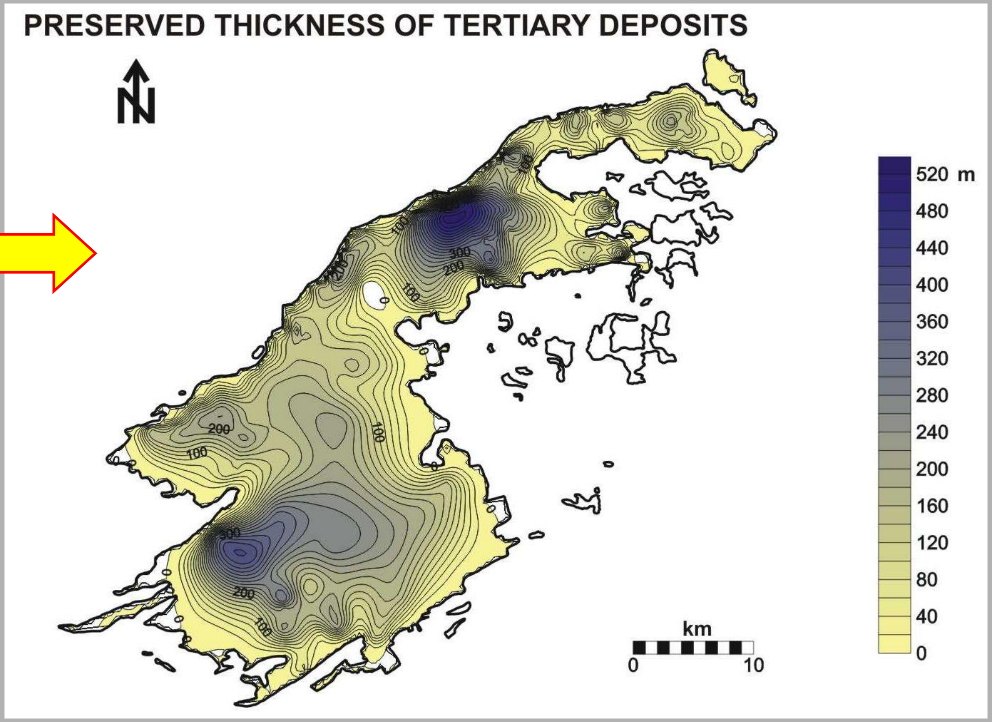
Eger Rift axis parallel to the Saxothuringian/Tepla-Barrandian suture


OHŘE RIFT
N
MOST
BASIN
Most
SOKOLOV
BASIN
Krušné Hory Fault Zone
Žatec
CHEB
BASIN
Doupov Mts.
Mariánské Lázně
Fault Zone
Ohře Fault Zone
Labe Fault Zone
České
Středohoří Mts.
ZITTAU
BASIN
Lužice Fault Zone
40 km
12°
14°
16°
18°
50°
49°
PRAHA
BRNO

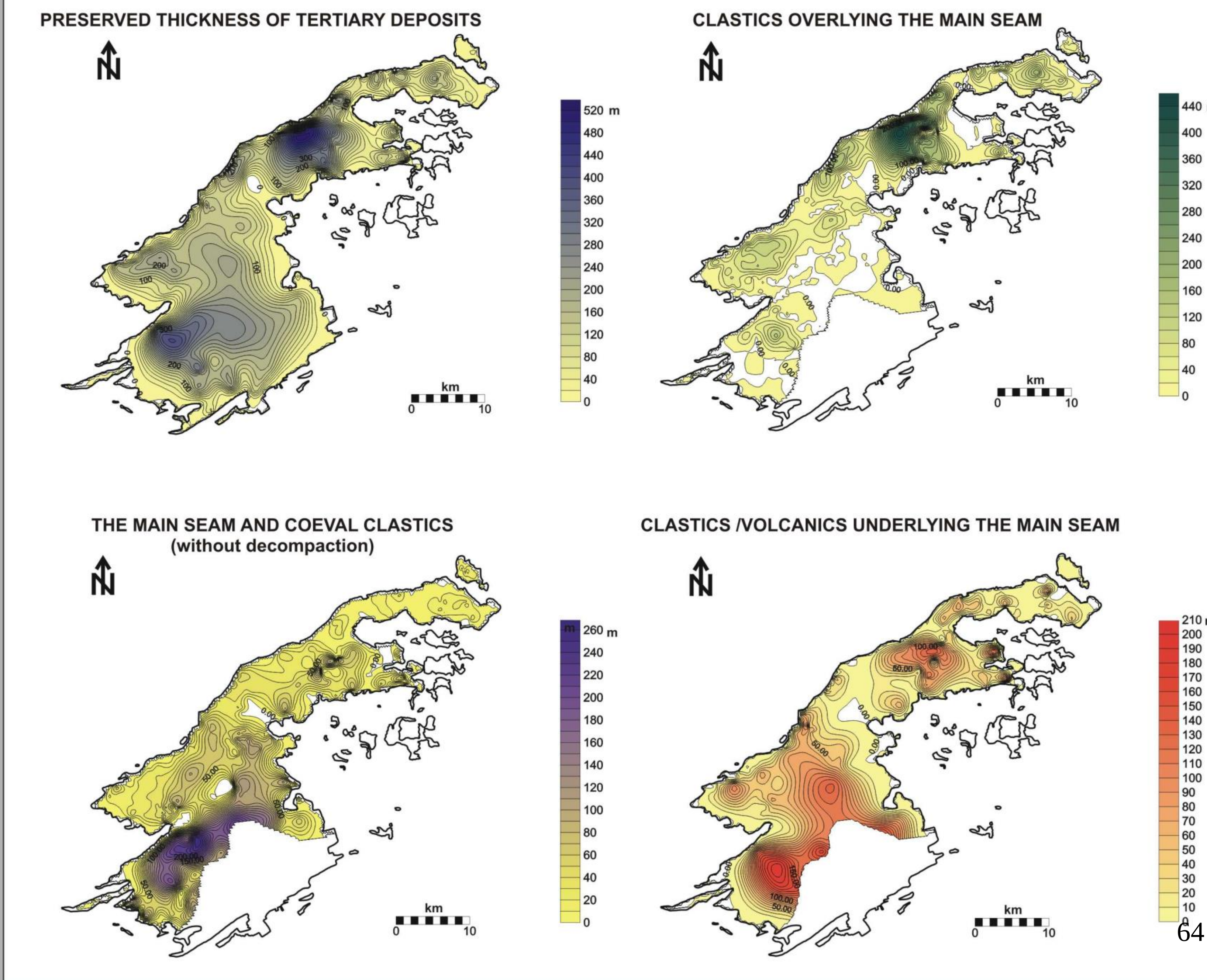

S
KRUŠNÉ HORY
TEPLICE
LITVÍNOV
ČESKÉ STŘEDOHOŘÍ
BÍLINA
MOST
CHOMUTOV
ŽATEC
DOUPOVSKÉ HORY
0
10
20 km
denudační okraj neogenních sedimentů
kontura neogenních vulkanitů
Copiright VTU Dobruška; ArcData Praha

THE MOST BASIN



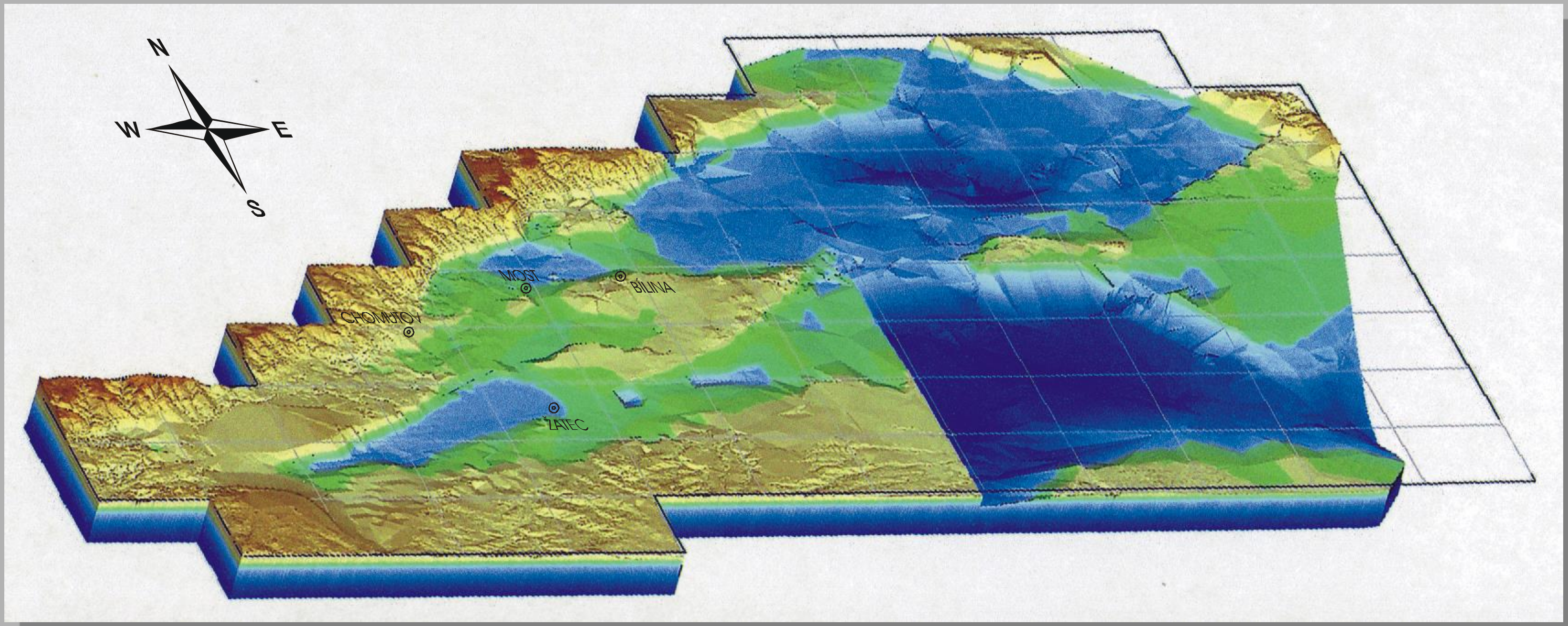


ISOPACH MAPS OF BASIN FILL - MOST BASIN

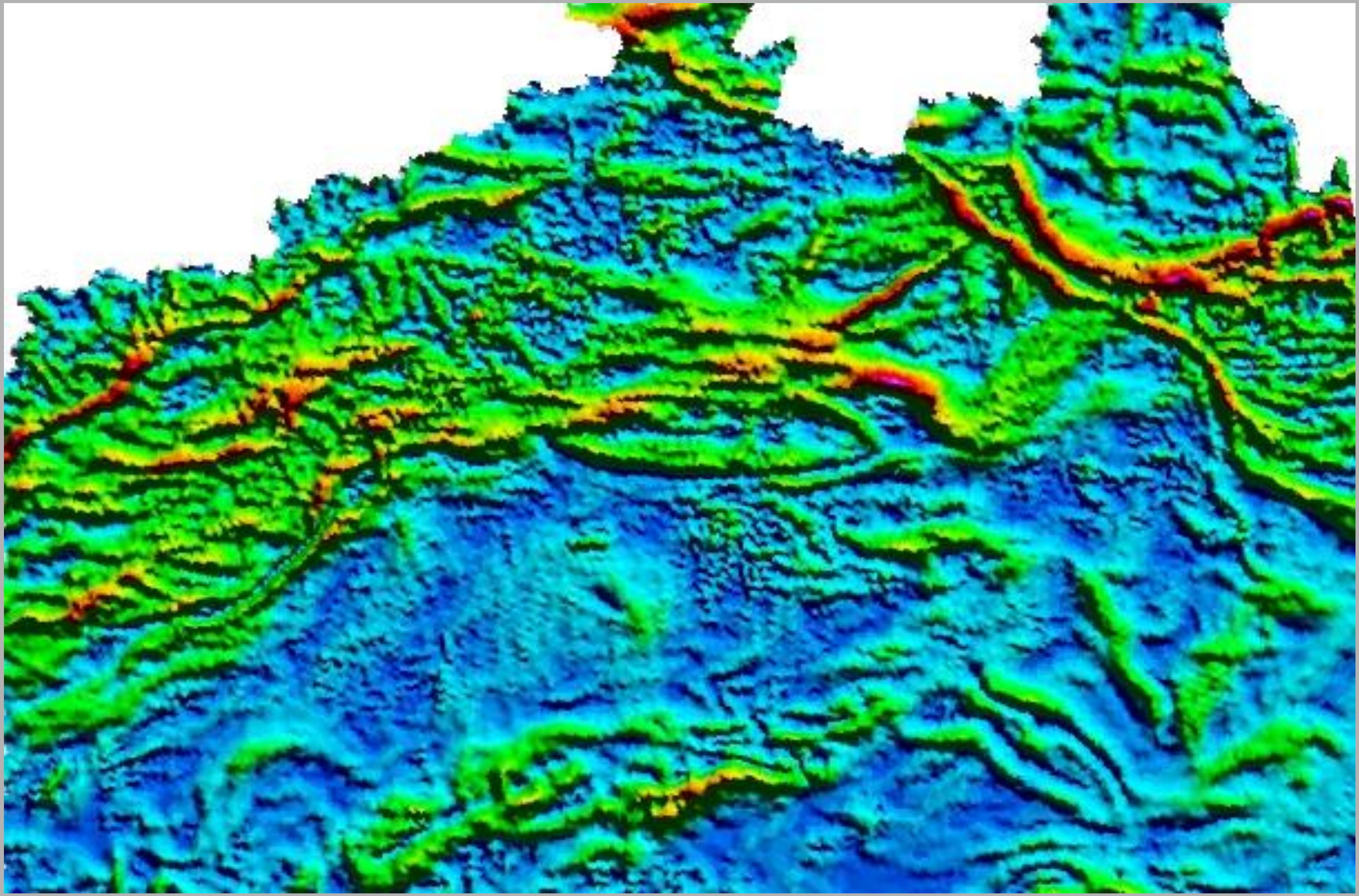


DMR KRYSTALINIKA V PODLOŽÍ MOSTECKÉ PÁNVE

(podle Mlčocha et al. 2002)

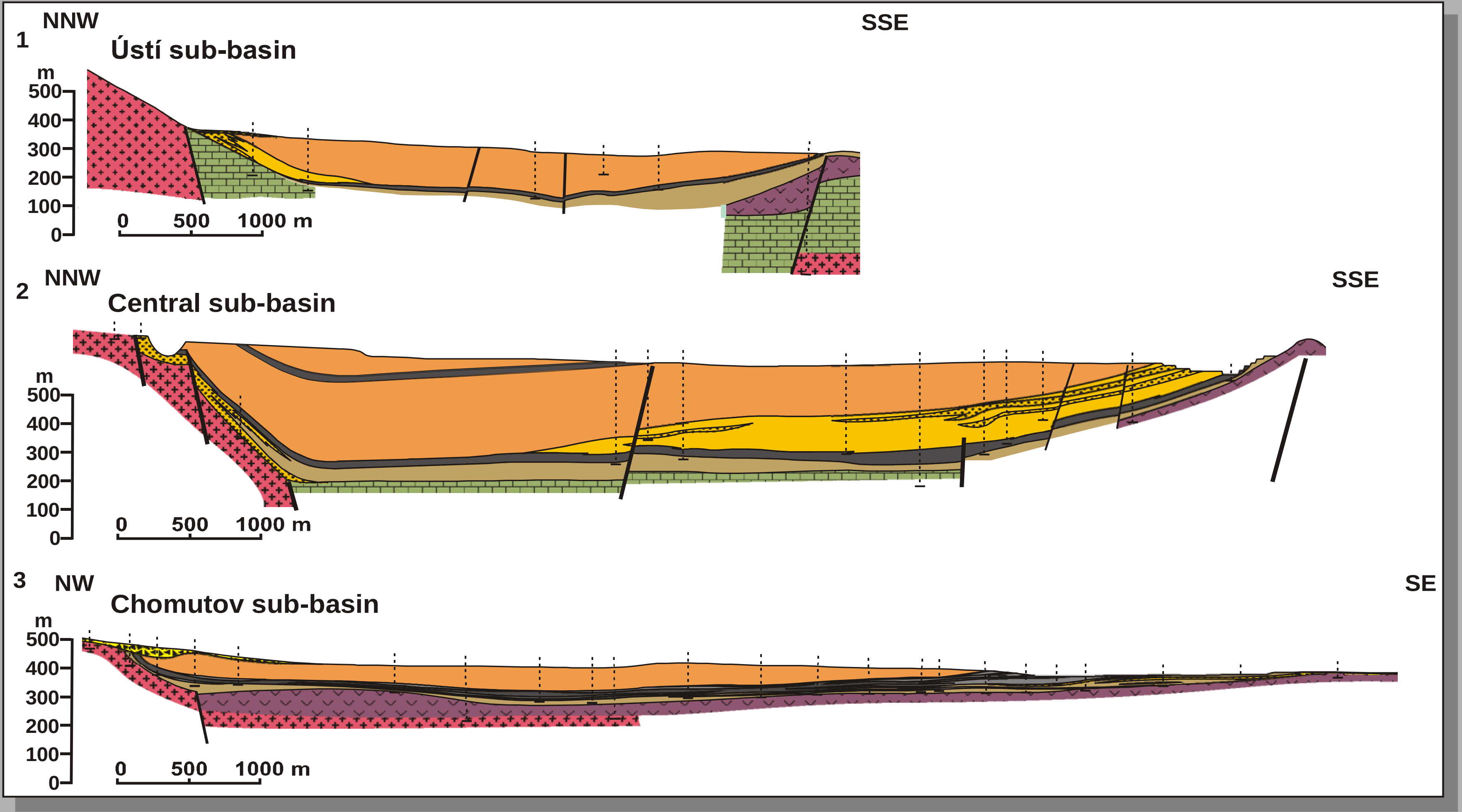


northern part of the Eger Rift

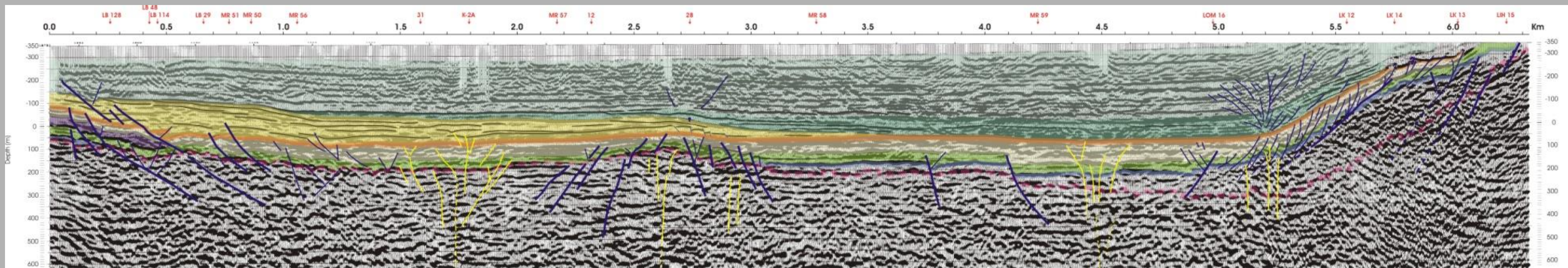


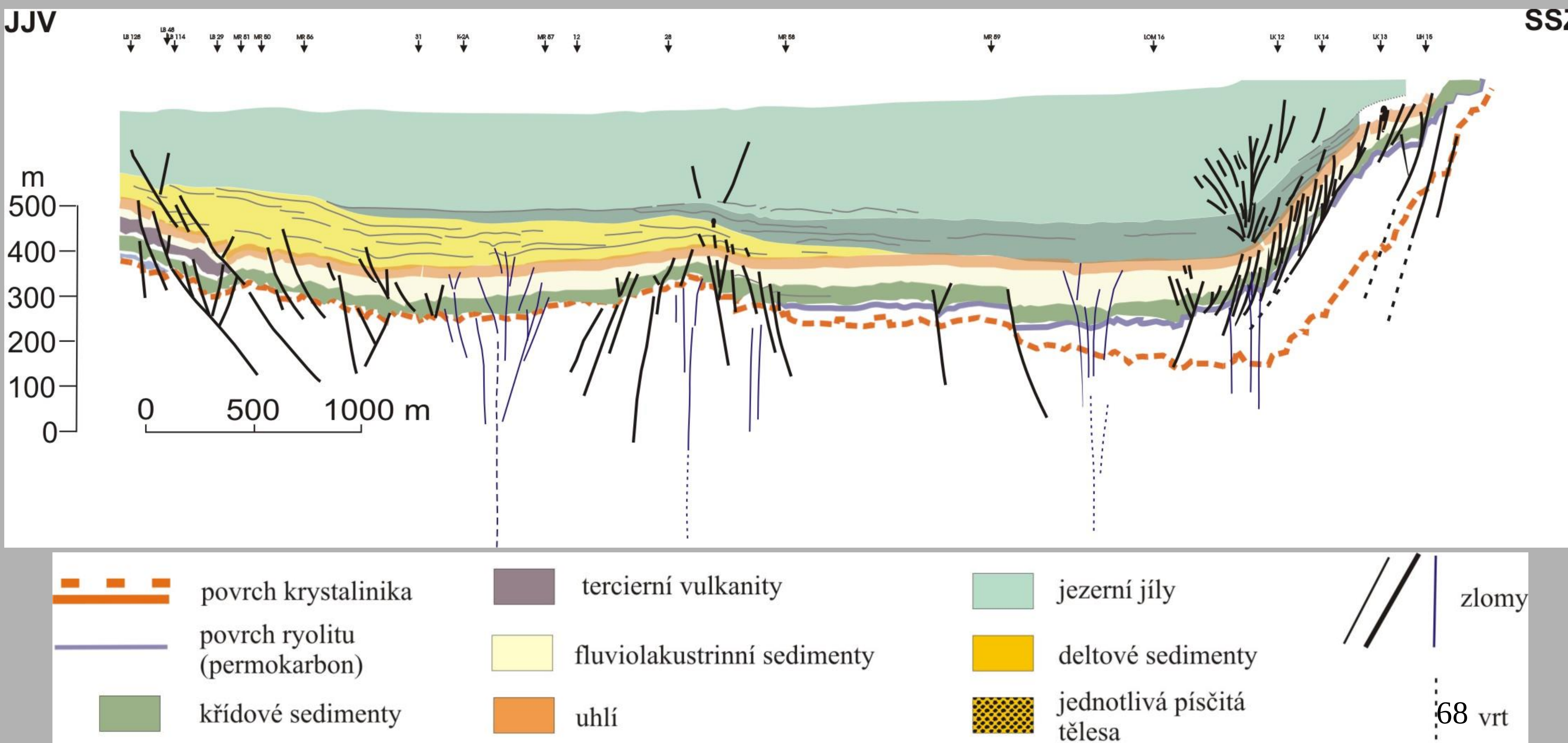
E-W structures in horizontal gravity gradients, illumination from the NNE

1. GEOMETRIE DEPOCENTER – GEOMETRIE VÝPLNĚ

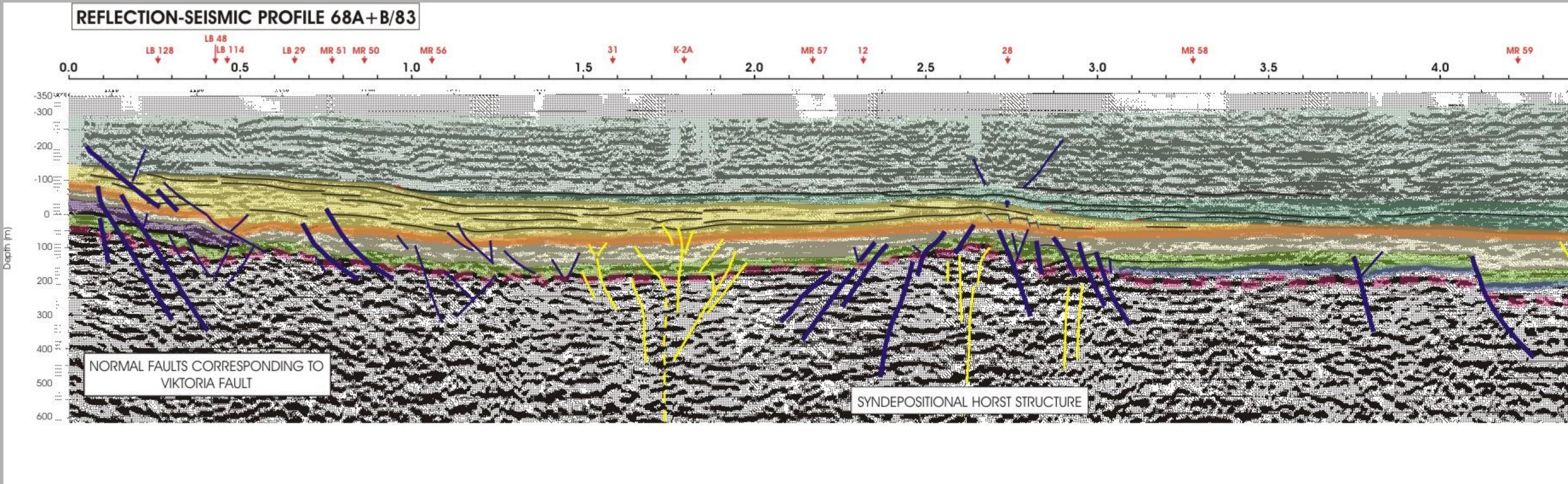


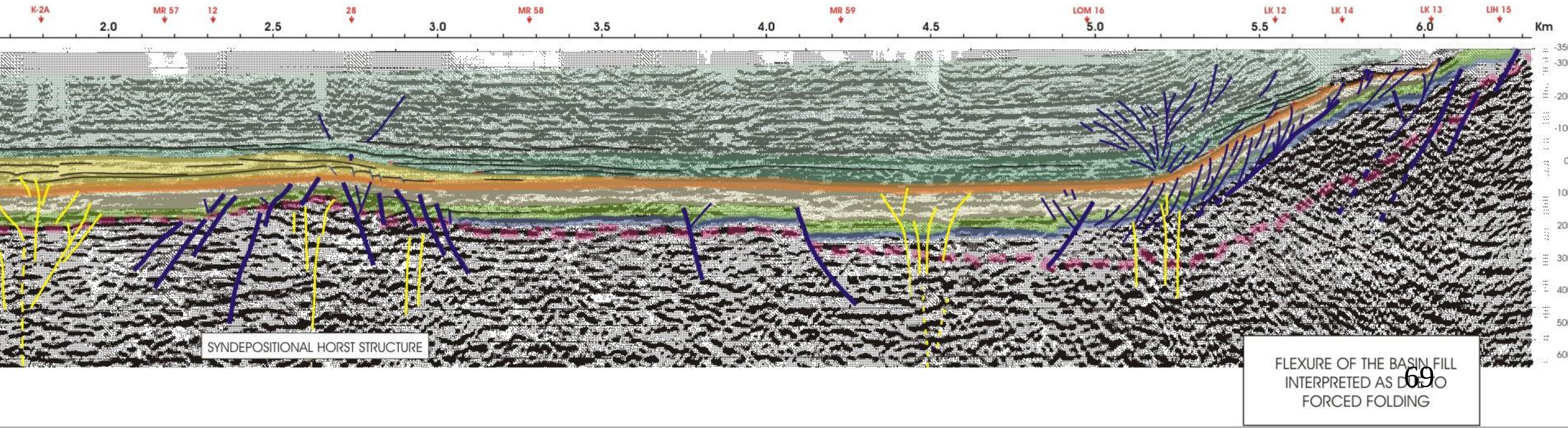
68A+B/83


0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Km
Depth (m)

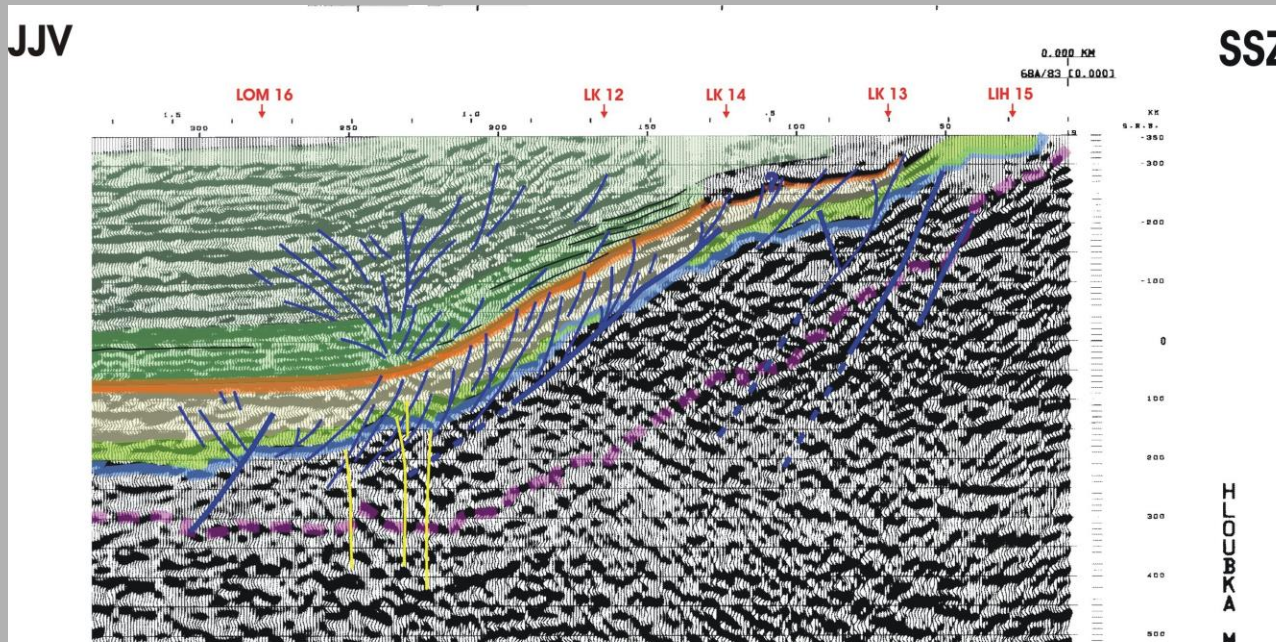

JJV
SSZ
LB 128
LB 48
LB 114
LB 29
MR 51
MR 50
MR 56
31
K-2A
MR 57
12
28
MR 58
MR 59
LOM 16
LK 12
LK 14
LK 13
LIH 15
m
500
400
300
200
100
0
0 500 1000 m
povrch krystalinika
povrch ryolitu (permokarbon)
křídové sedimenty
terciérní vulkanity
fluviolakustrinní sedimenty
uhlí
jezerní jíly
deltové sedimenty
jednotlivá písčitá tělesa
zlomy
vrt

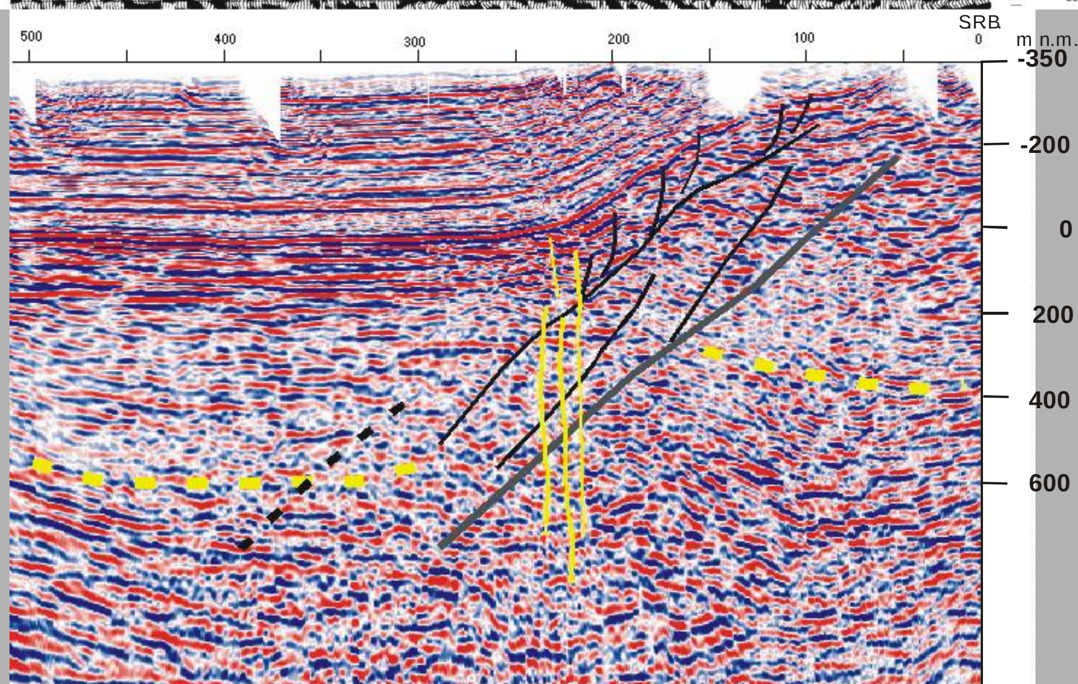
History of the Most Basin
summarized in the seismic reflection line 68/83

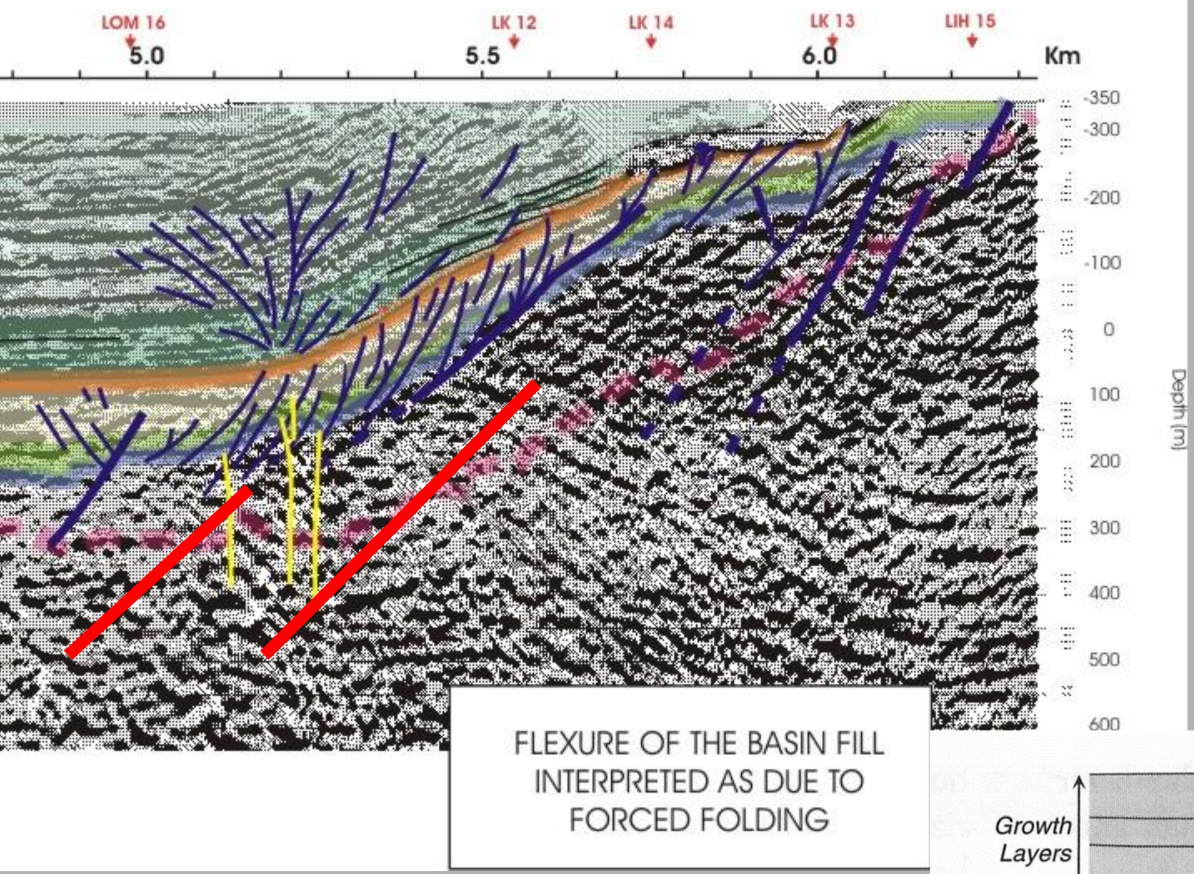




Tektonická interpretace krošnohorského okraje mostecké pánve

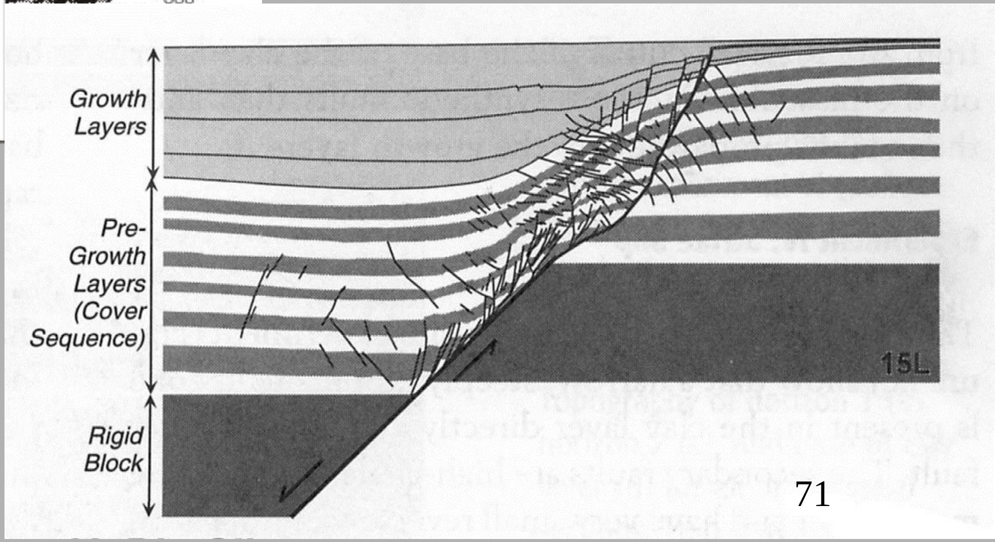






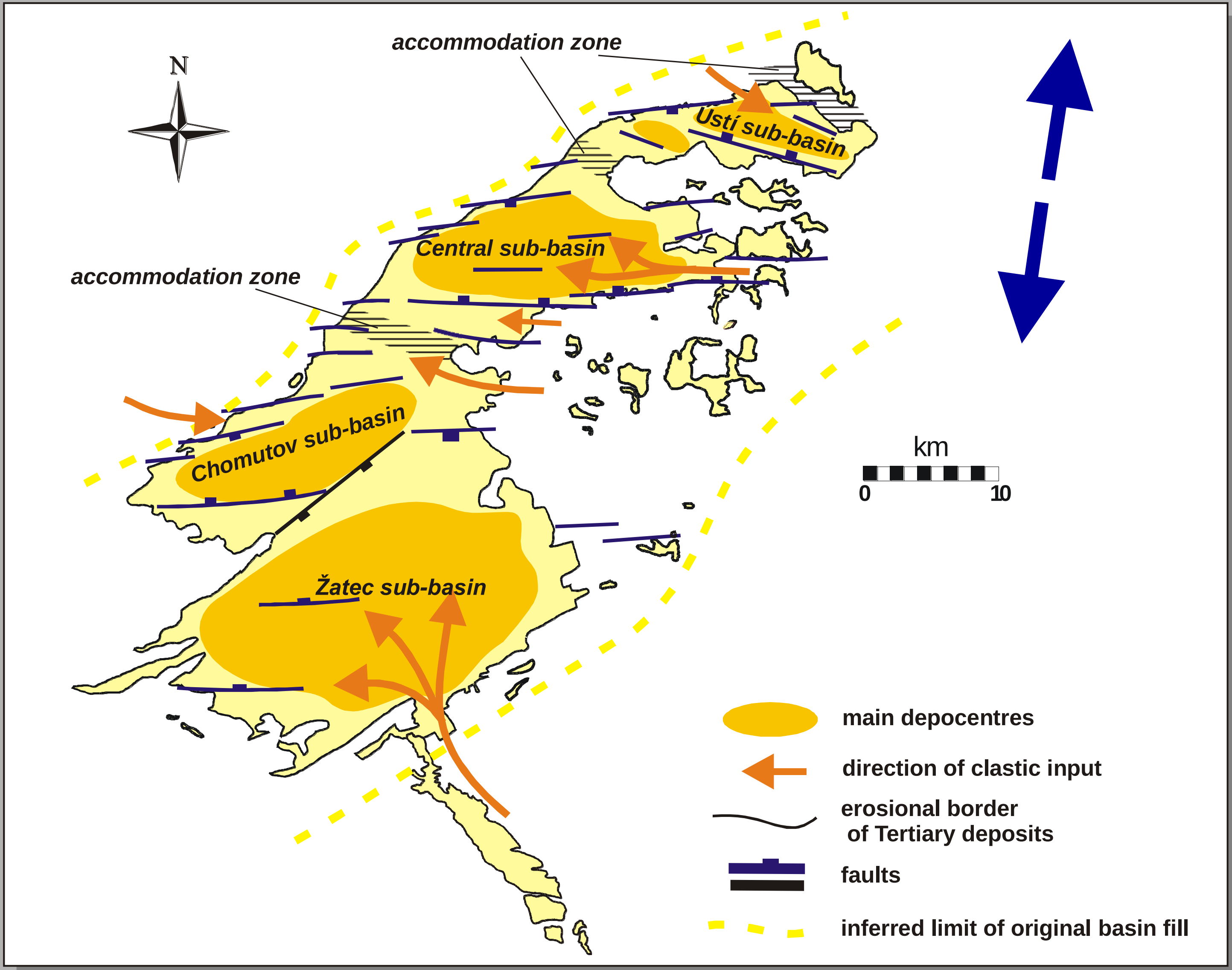
Krušné Hory/Erzgebirge Mts. uplift: Plio-Pleistocene, deformation of part of basin fills

vertical diplacement over 1000 m

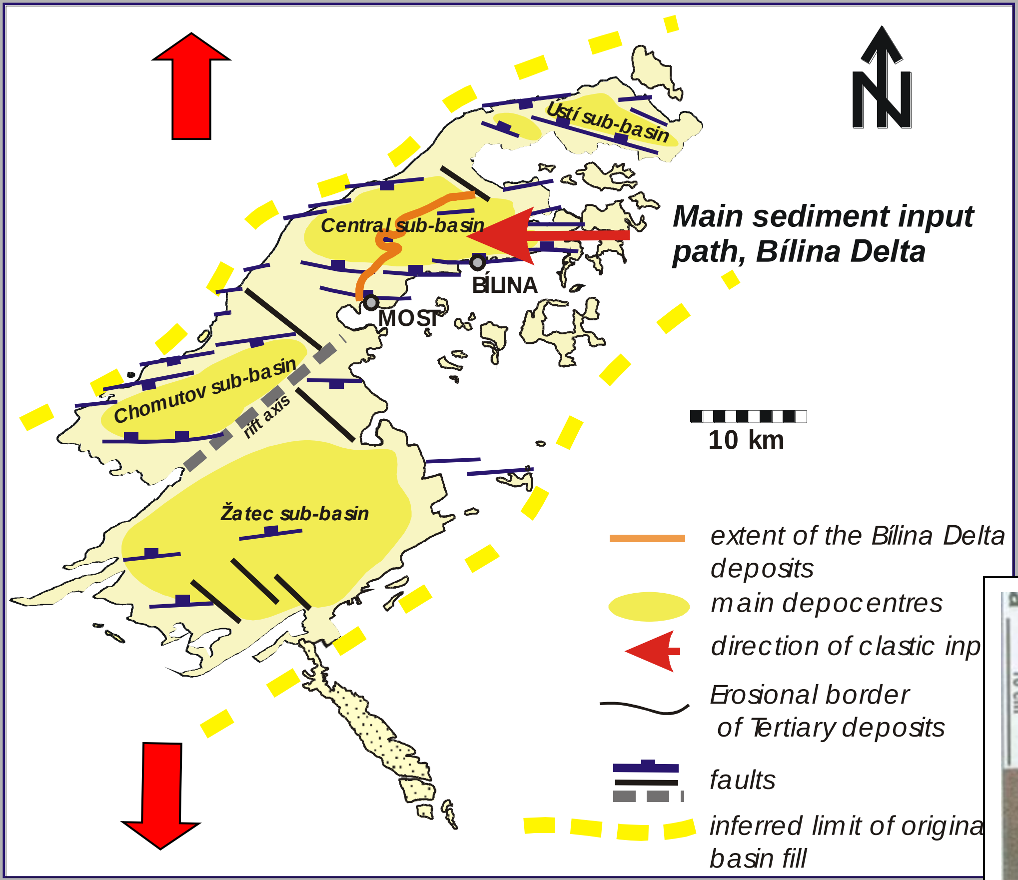


analogue model from Schlische et al., 2002

TEKTONICKÝ MODEL MOSTECKÉ PÁNVE



FORMATION OF MOST BASIN: OBLIQUE EXTENSION



short E-W normal fault segments

en-echélon arangement

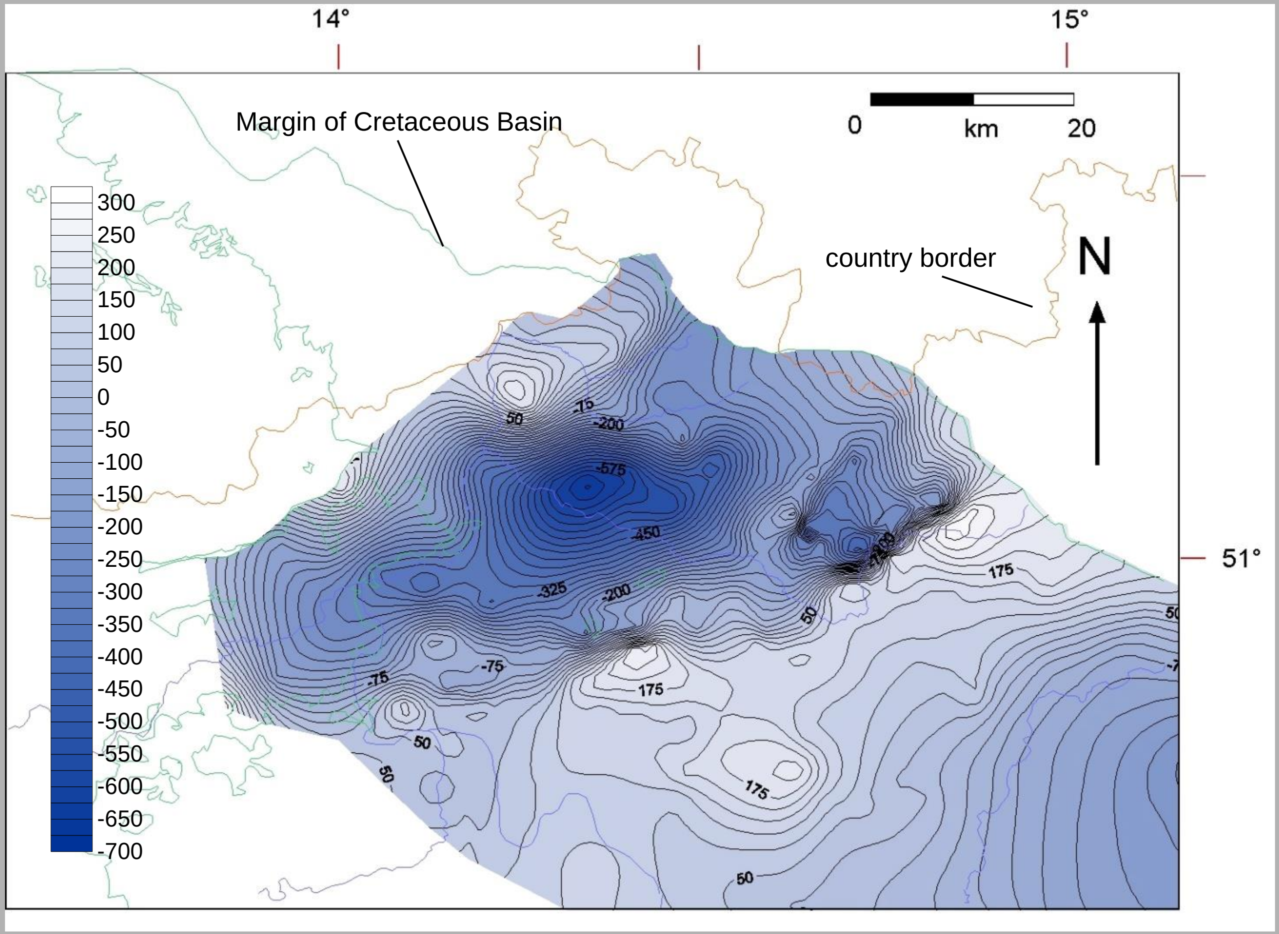
partly overlapping depocenters separated by accommodation /transfer zones

approx. N-S extension in Mid-Oligocene to early Miocene

(also: volcanic body geometries, Adamovič & Coubal, 1999)

comparison: analogue model from McClay, 2002

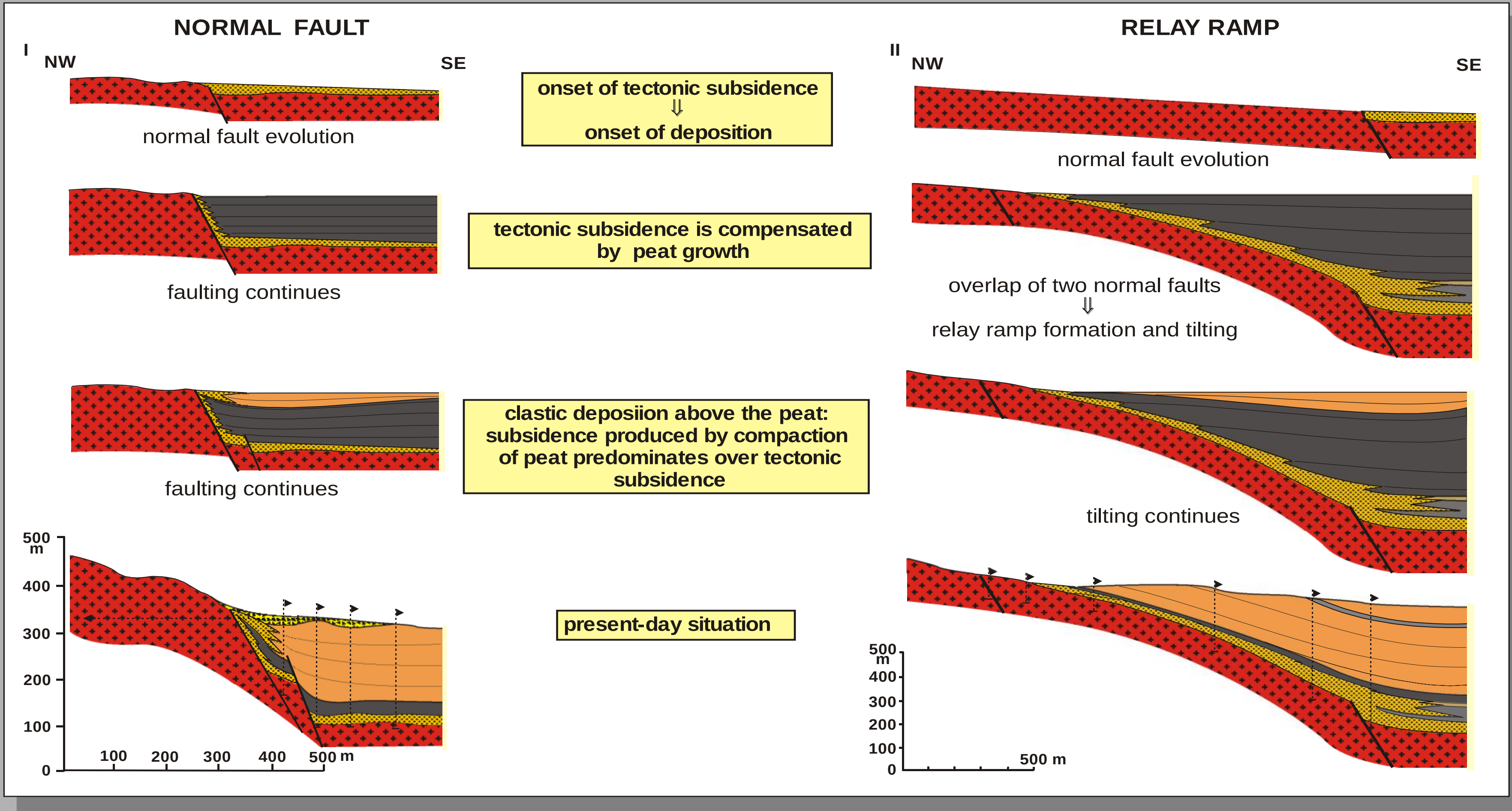
Northern Eger Rift – graben geometry



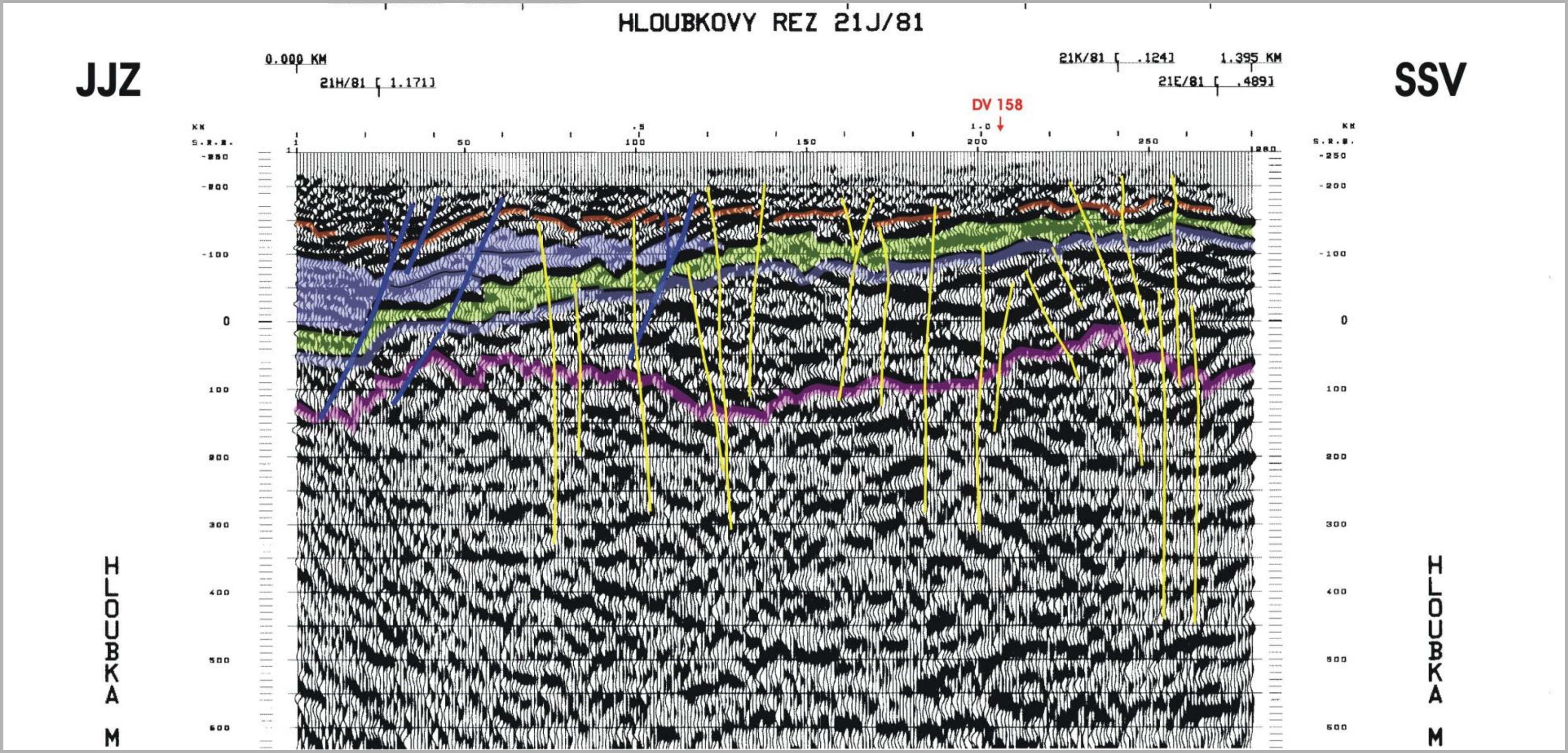
no preserved Cenozoic basins, but subsided blocks of pre-rift strata (Cretaceous) mark E-W faults and graben geometries

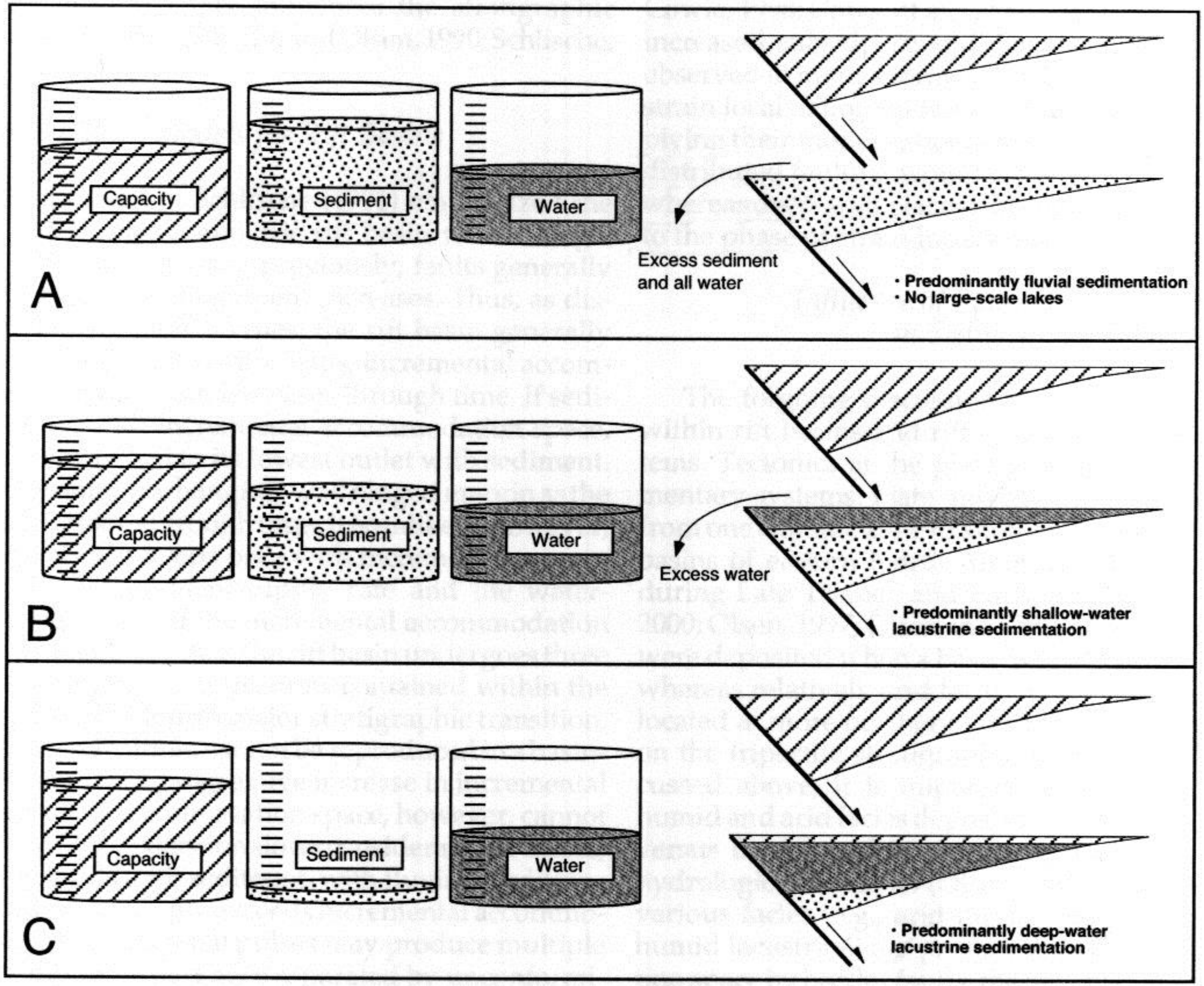
-655 to 295 m elevation, base of Turonian deposits (mid/Cretaceous, quasi-horizontal marker surface); based on c. 500 boreholes

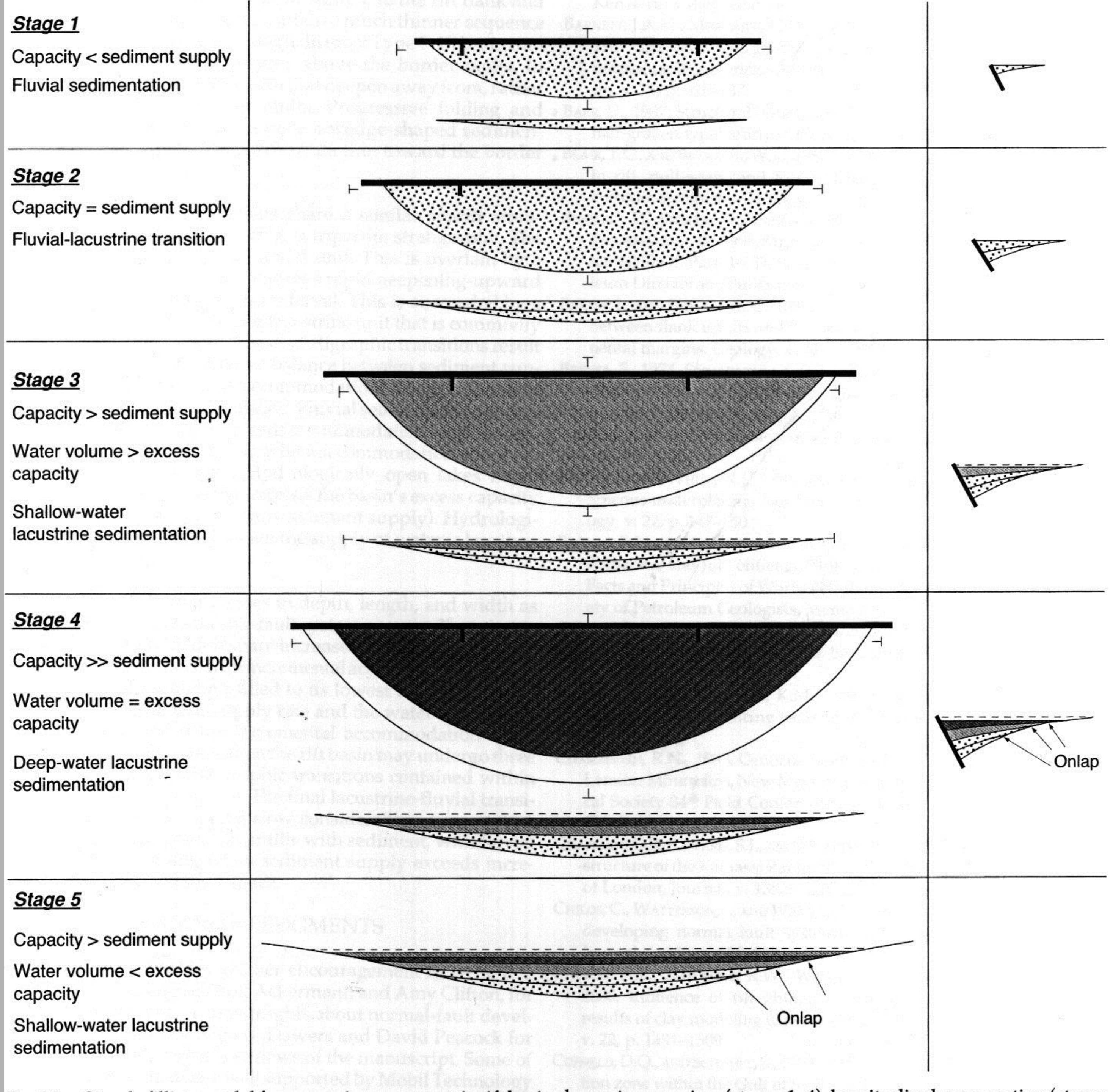
1. VLIV KOMPAKCE RAŠELINY NA POVRCHOVÝ PROJEV ZLOMOVÉHO SYSTÉMU



JZ okraj transferové zóny zastižené profilem 21/81




Capacity
Sediment
Water
Excess sediment
and all water
A
· Predominantly fluvial sedimentation
· No large-scale lakes
Capacity
Sediment
Water
Excess water
B
· Predominantly shallow-water
lacustrine sedimentation
Capacity
Sediment
Water
C
· Predominantly deep-water
lacustrine sedimentation


Stage 1
Capacity < sediment supply
Fluvial sedimentation
Stage 2
Capacity = sediment supply
Fluvial-lacustrine transition
Stage 3
Capacity > sediment supply
Water volume > excess capacity
Shallow-water lacustrine sedimentation
Stage 4
Capacity >> sediment supply
Water volume = excess capacity
Deep-water lacustrine sedimentation
Onlap
Stage 5
Capacity > sediment supply
Water volume < excess capacity
Shallow-water lacustrine sedimentation
Onlap

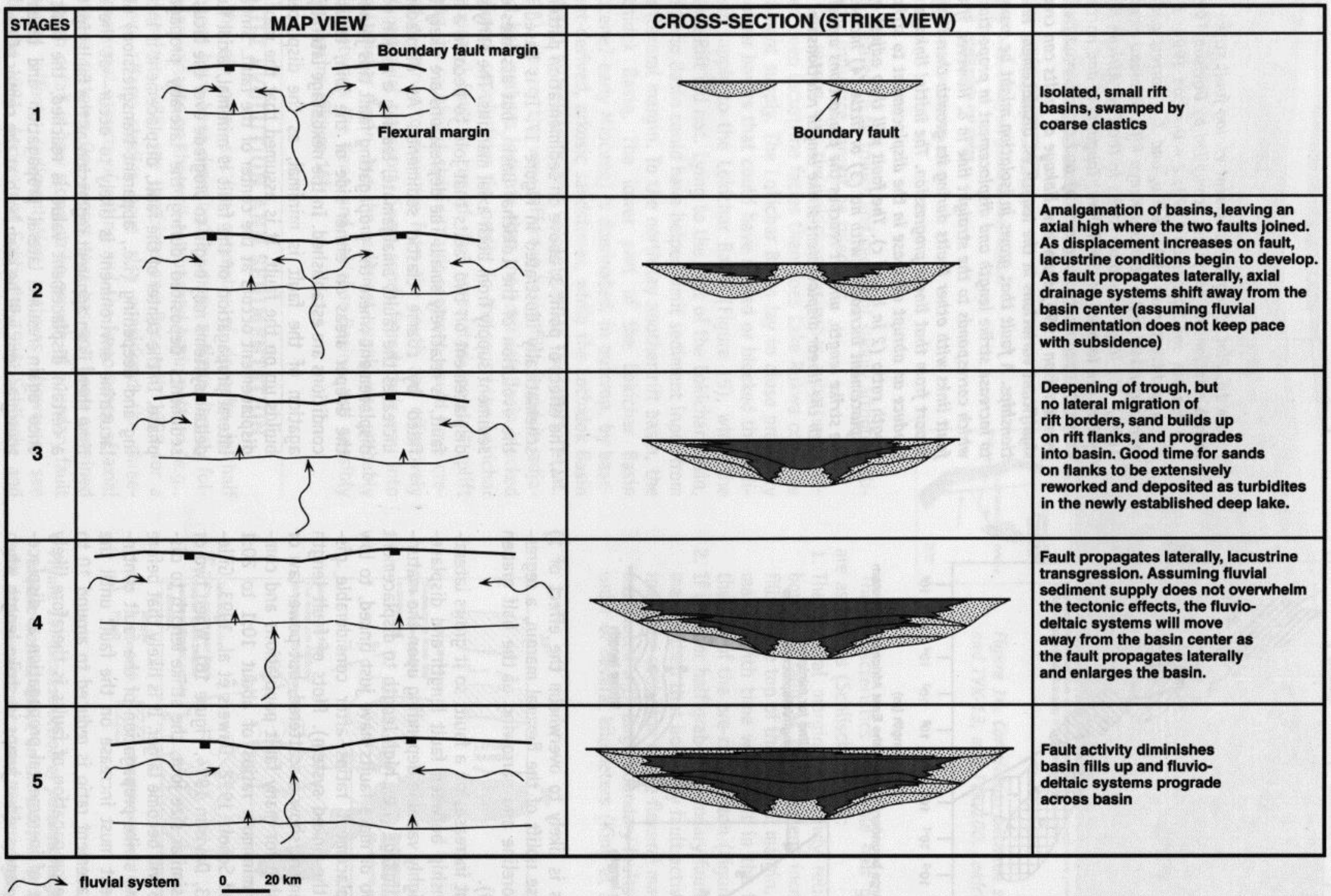


Figure 17. Idealized strike section evolution of a half graben, emphasizing how the lateral propagation and evolution of a boundary fault zone can influence sedimentation patterns.

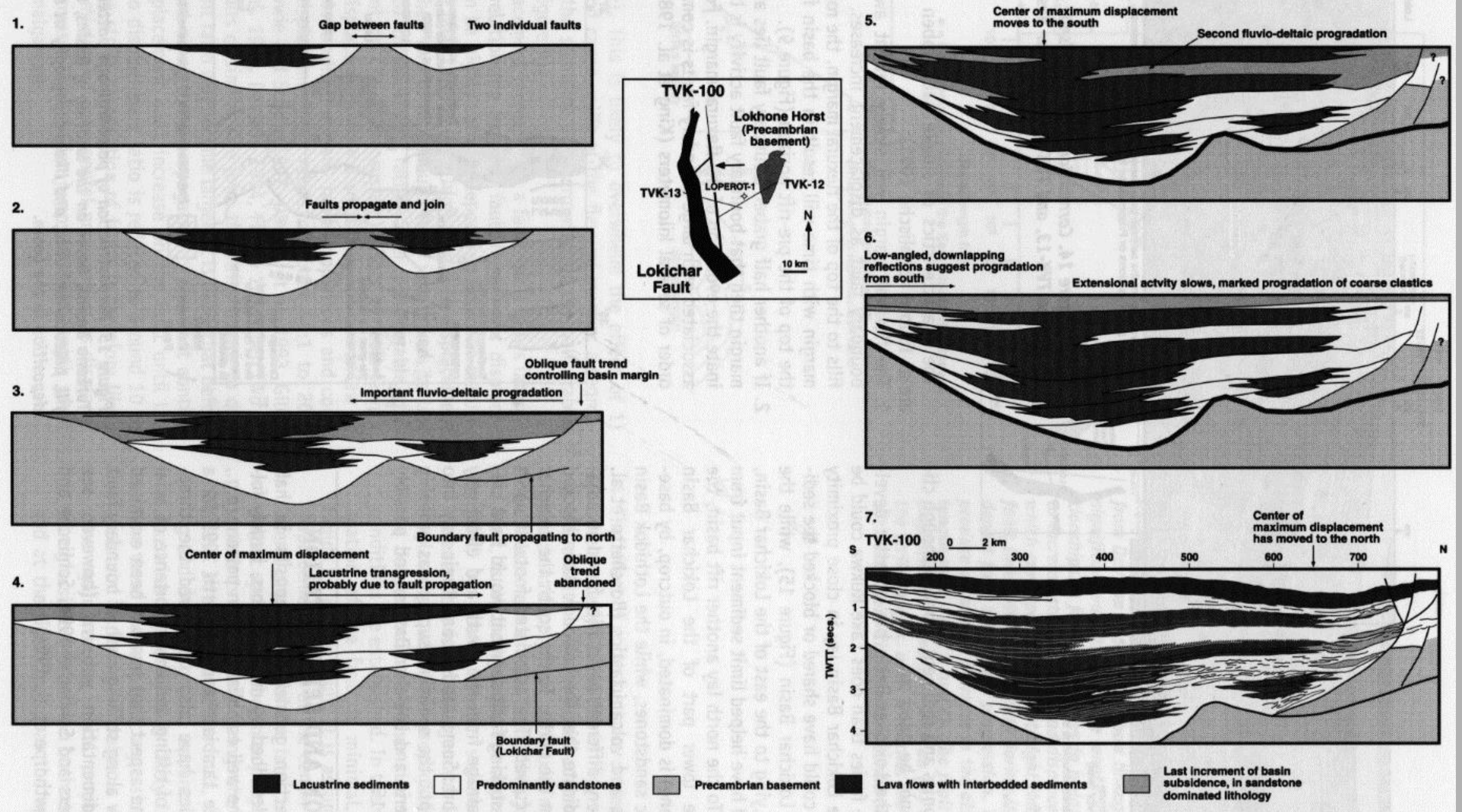


Figure 13. Evolution of seismic line TVK-100, Lokichar Basin, Kenya, based on Figure 12.