The Geologic Story of the Carpathians

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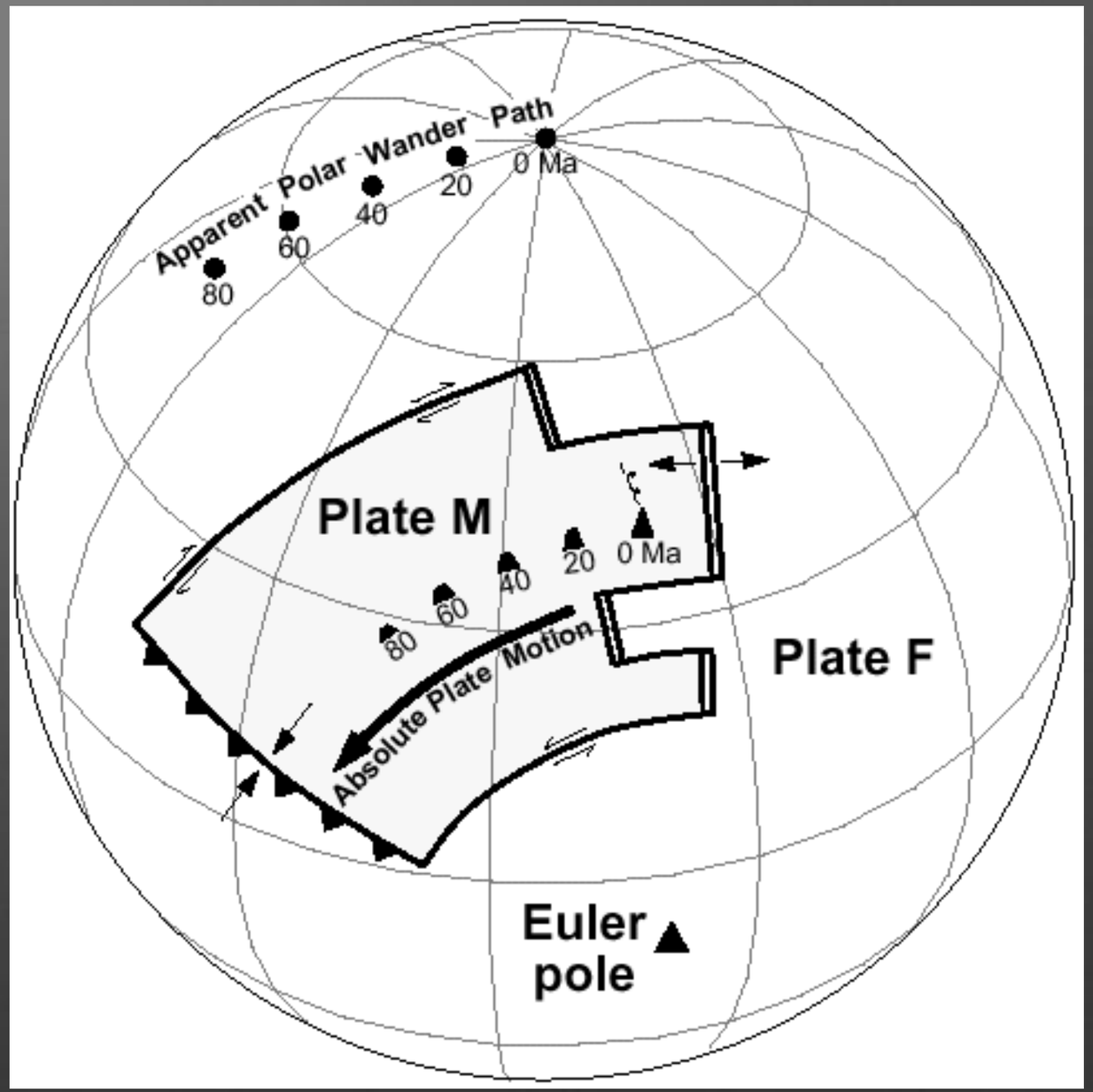
FIELD
GEOLOGIST
WE SOLVE PROBLEMS
YOU DIDN'T KNOW YOU HAD
IN WAYS YOU DON'T
UNDERSTAND


Apparent Polar Wander Path
80
60
40
20
0 Ma
Plate M
Plate F
Absolute Plate Motion
Euler pole

Puerto Vallarta

Summary

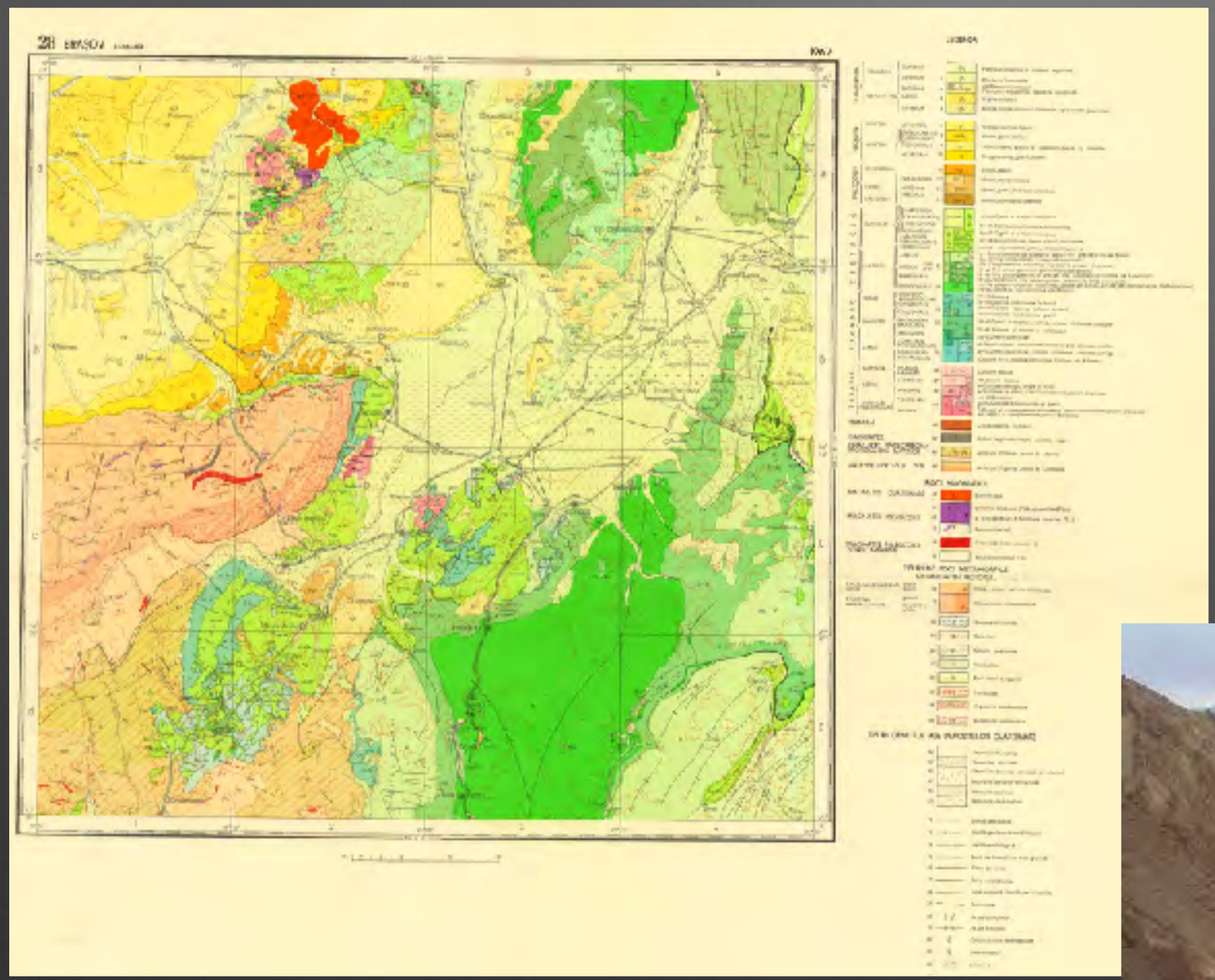
- Early formation of the island arcs (800-400 Ma)
- Big Crush and assembly (400-250 Ma)
- The Alpine Oceans and their islands and volcanoes

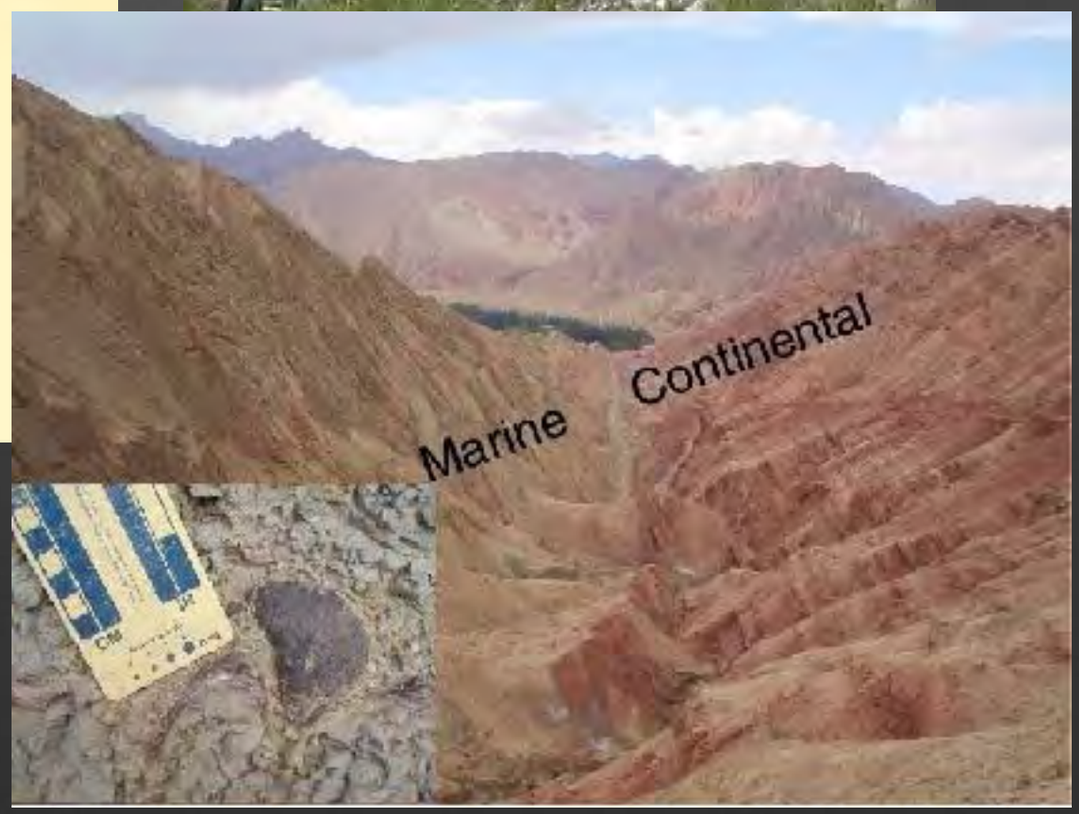
All buttressed by older, more rigid blocks

RÉPUBLIQUE SOCIALISTE

ROUMANIE

CARTE GÉOLOGIQUE




Marine
Continental

M. SĂNDULESCU

HARTA TECTONO-STRUCTURALĂ A ROMÂNIEI

0 10 20 30 km

LEGENDA

OROGENUL CARPATIC

DACIDE INTERNE

TRANSILVANICE

Metalifer și SITRIC

PIENIDE

DACIDE MEDIANE

FACIESE EXTERNE

DACIDE MARGINALE

MOLDAVIDE

ELEMENTE POST-TECTOGENETICE

OROGENUL NORD-DOBROGEAN

PLATFORME

U.

R.

R. F. UNGARIA

R. S. F. IUGOSLAVIA

R. P. BULGARIA

MAREA NEAGRĂ

SATU MARE

ORADEA

CLUJ-NAPOCA

TÎRGU MUREȘ

ARAD

TIMIȘOARA

SIBIU

BRAȘOV

EUCEAVA

IAȘI

ROMAN

BACĂU

GALAȚI

BRĂILA

BUZĂU

TÎRGU JIU

PITEȘTI

PLOIEȘTI

CRAIOVA

BUCUREȘTI

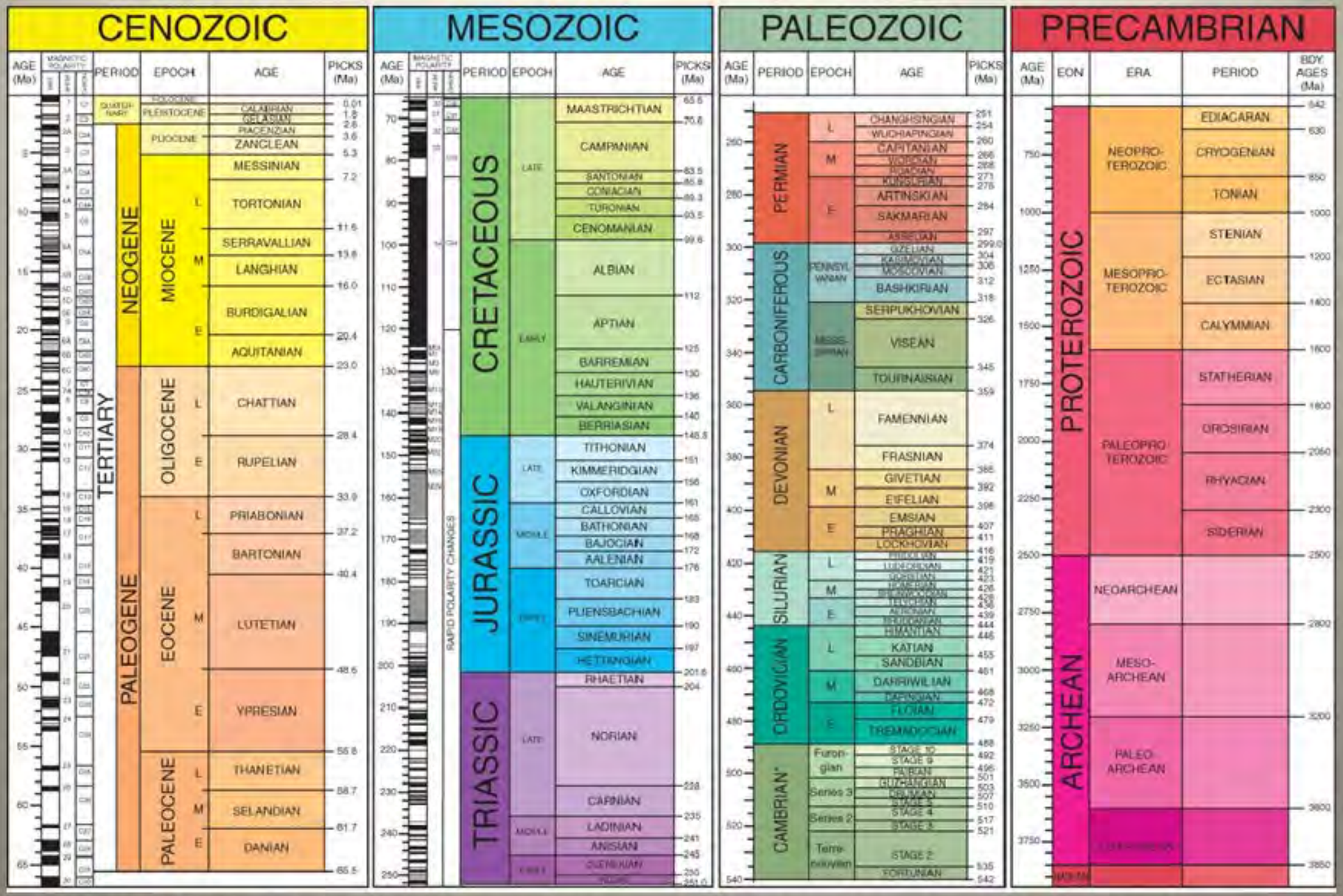
CONSTANȚA

BELGRAD

KRAGUIEVAC

DUNĂREA

2009 Geologic Time Scale



Subdividing 4.6 billion years into smaller, more “manageable” intervals

Alpine orogeny

Variscan

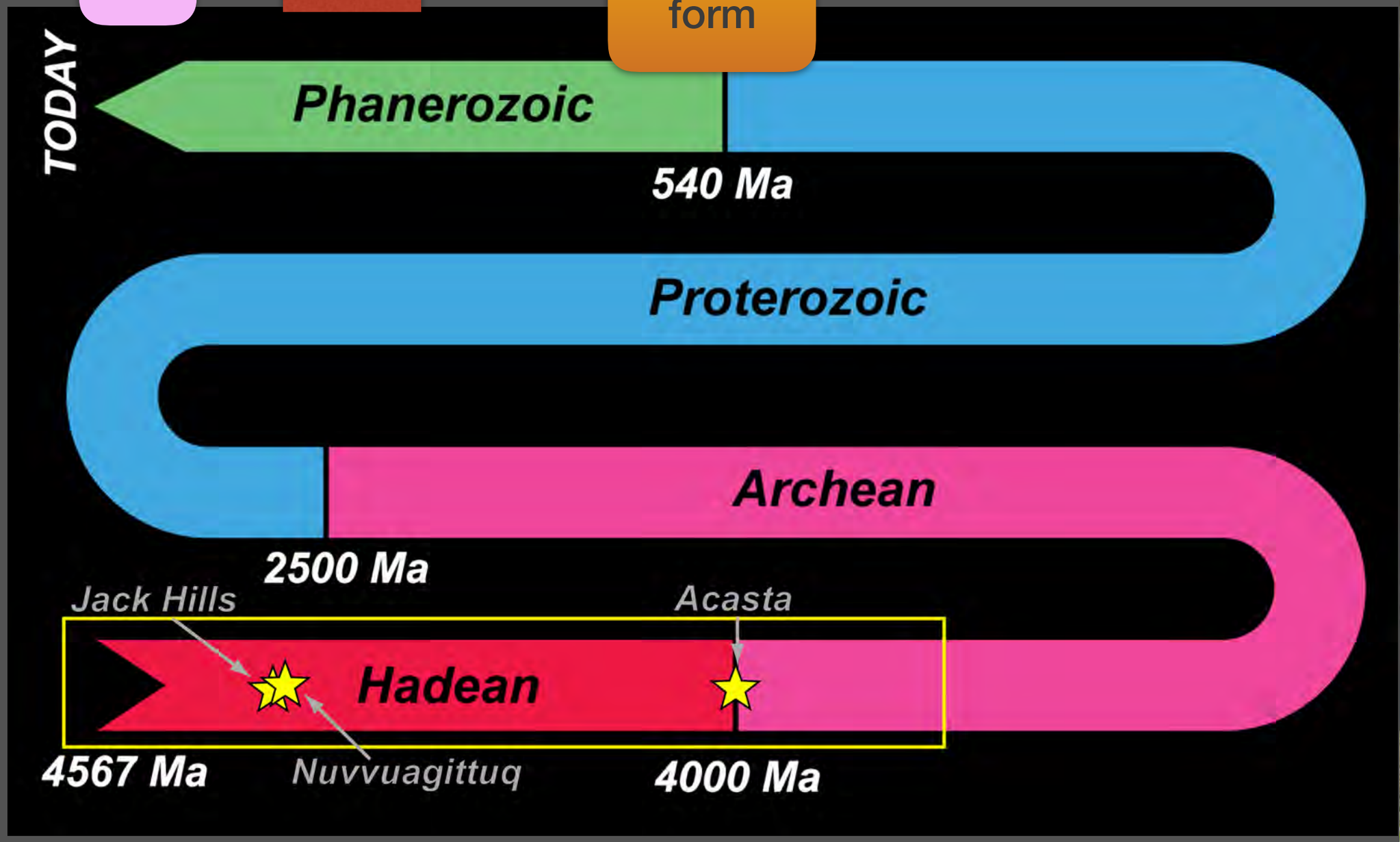
Caledonian-Cadomian

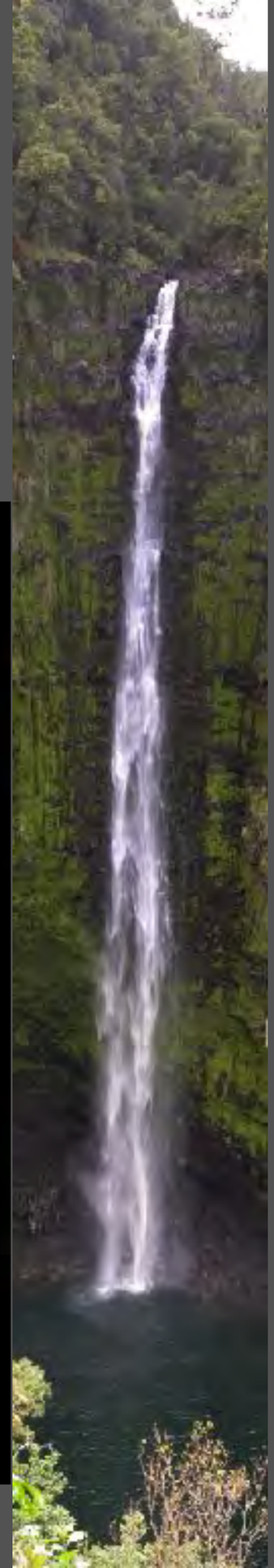
big bang

para-tethys

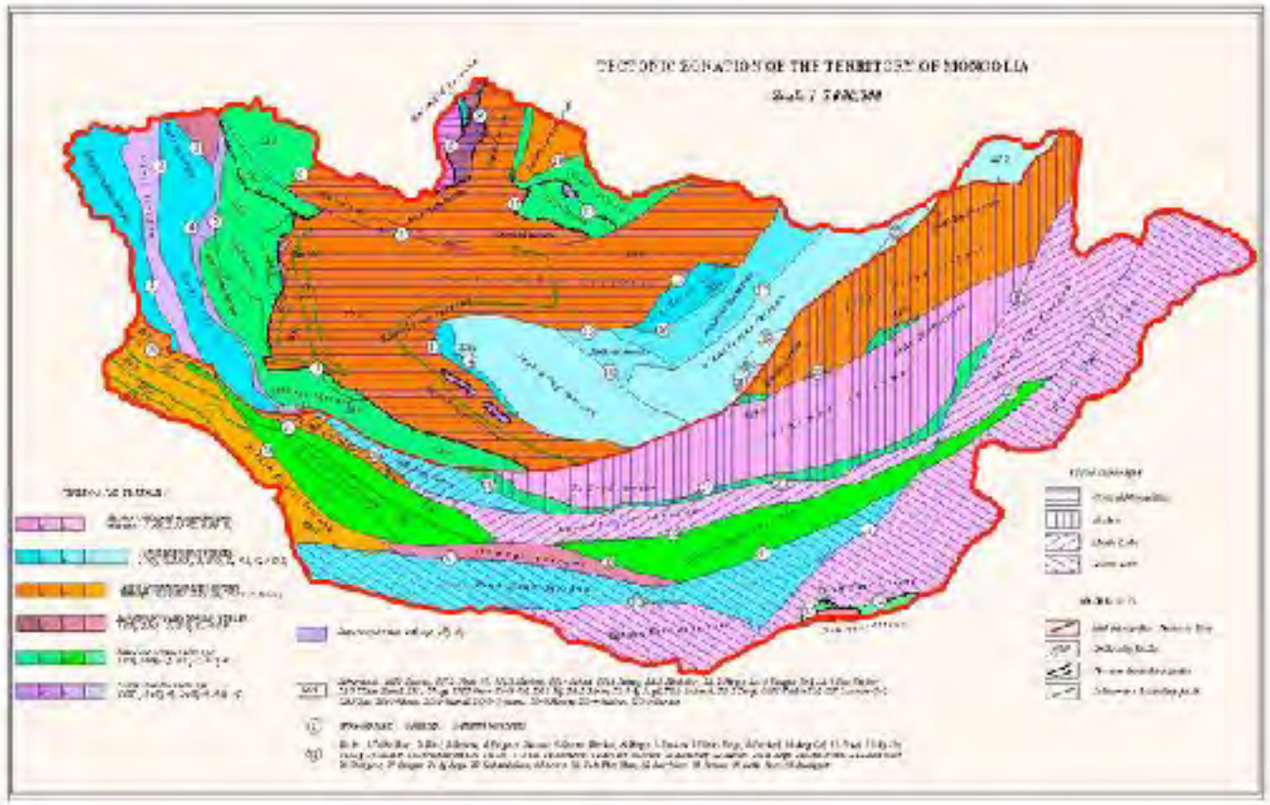
tethys

carpy form

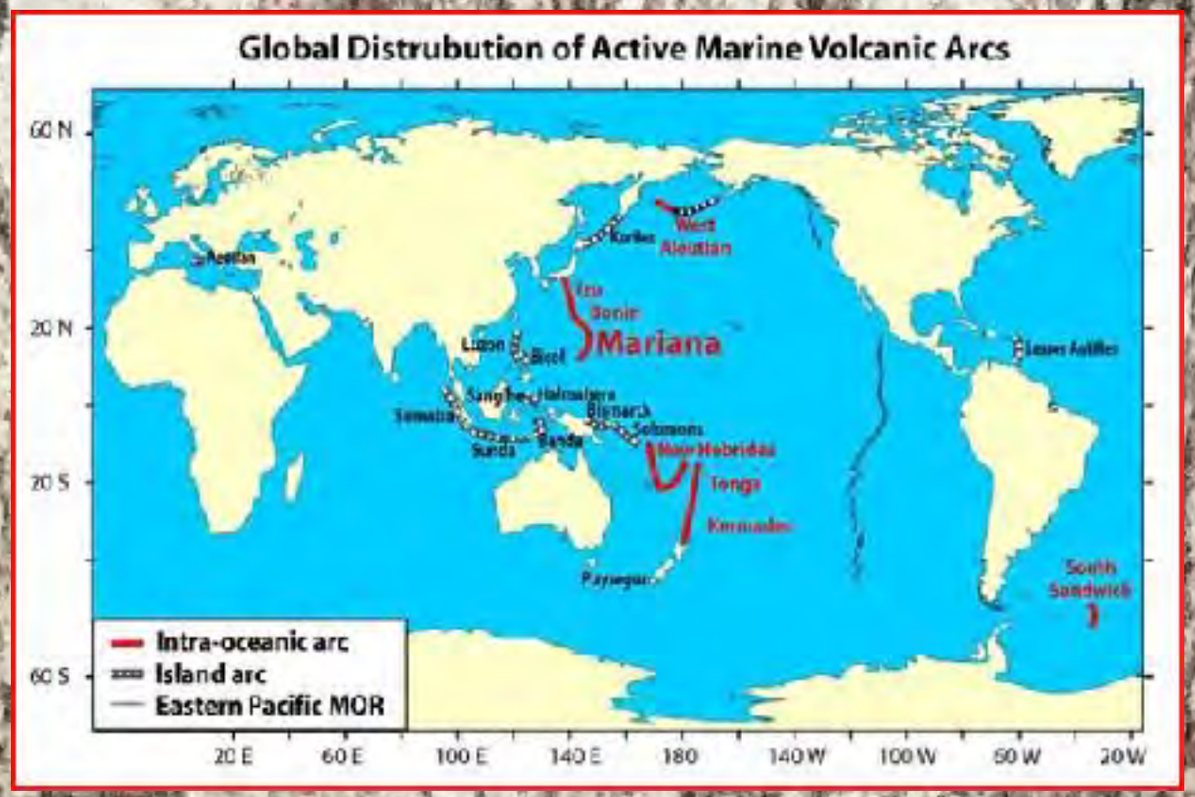


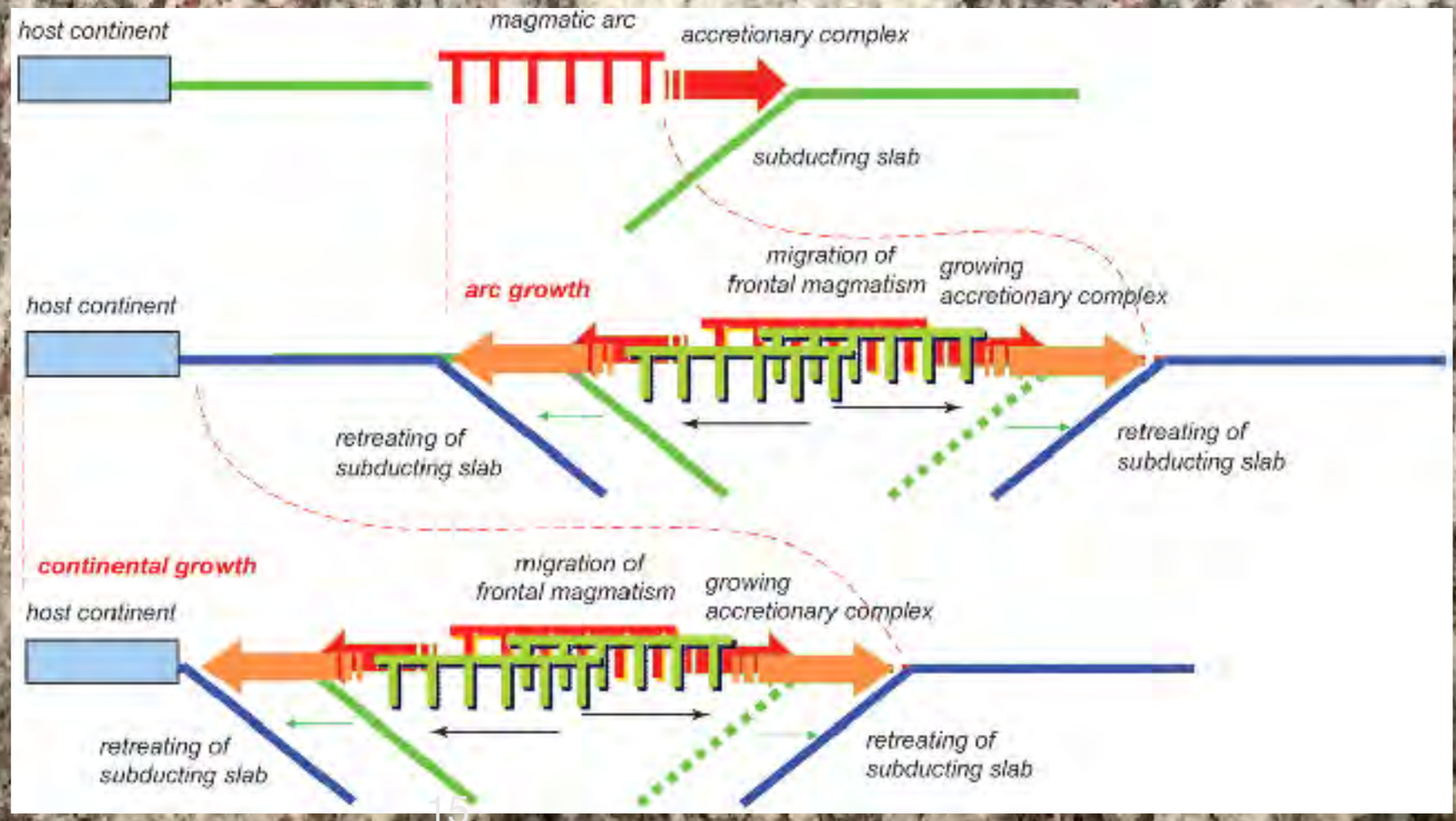


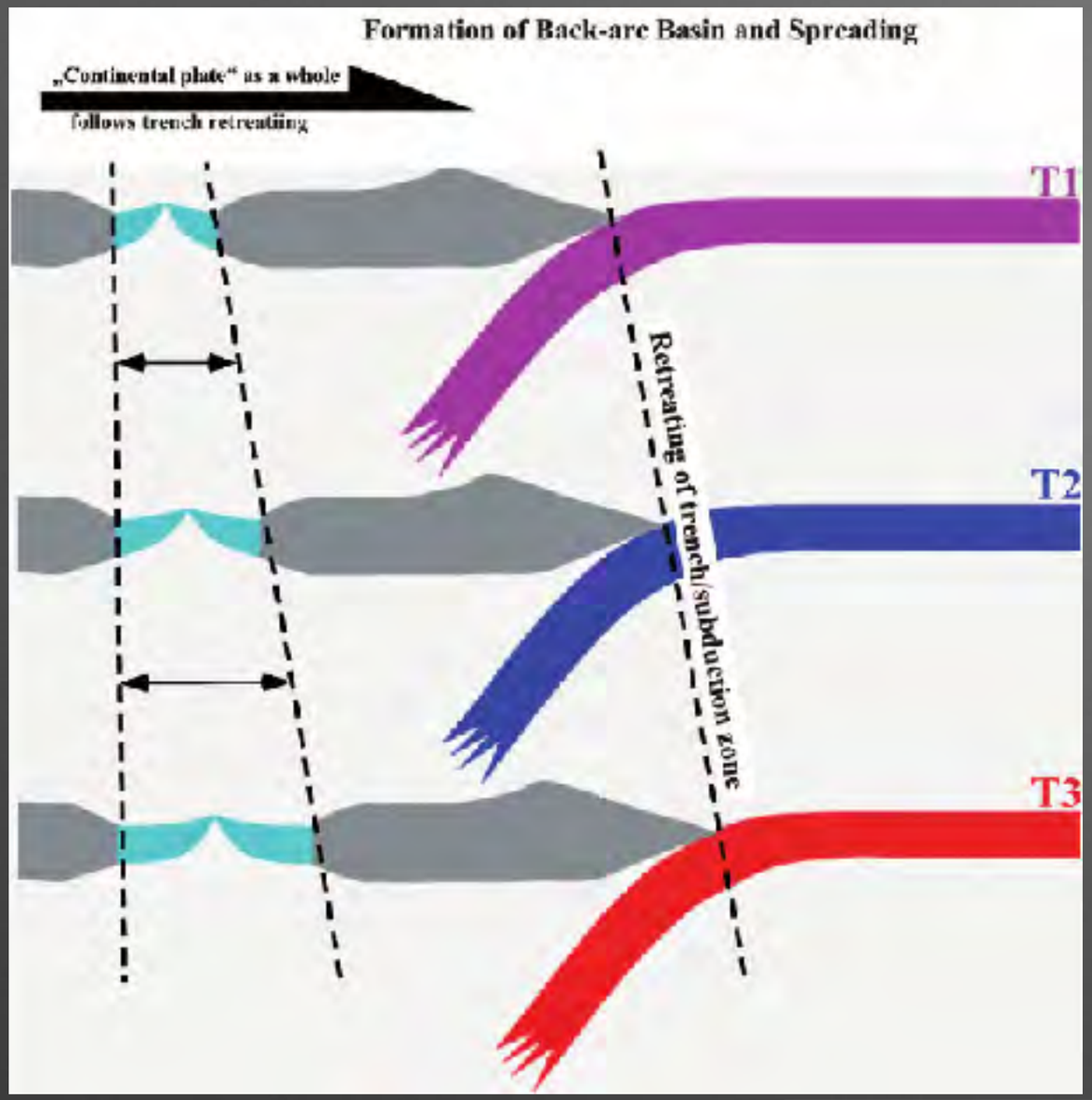

PAKISTAN
INDIA
MYANMAR
THAILAND
TAIWAN
PHILIPPINES
SOUTH CHINA SEA
BRUNEI
SINGAPORE
INDONESIA
PAPUA NEW GUINEA
NORTH PACIFIC OCEAN
ARABIAN SEA
SRI LANKA
MALDIVES
SEYCHELLES
INDIAN OCEAN
MAURITIUS
AUSTRALIA
VANUATU
FIJI
TONGA
SAMOA
FRENCH POLYNESIA
NEW ZEALAND
TASMAN SEA
GREAT SOUTHERN OCEAN
ANTARCTICA
ISLAND ARCS
SINGAPORE-ANTARCTICA

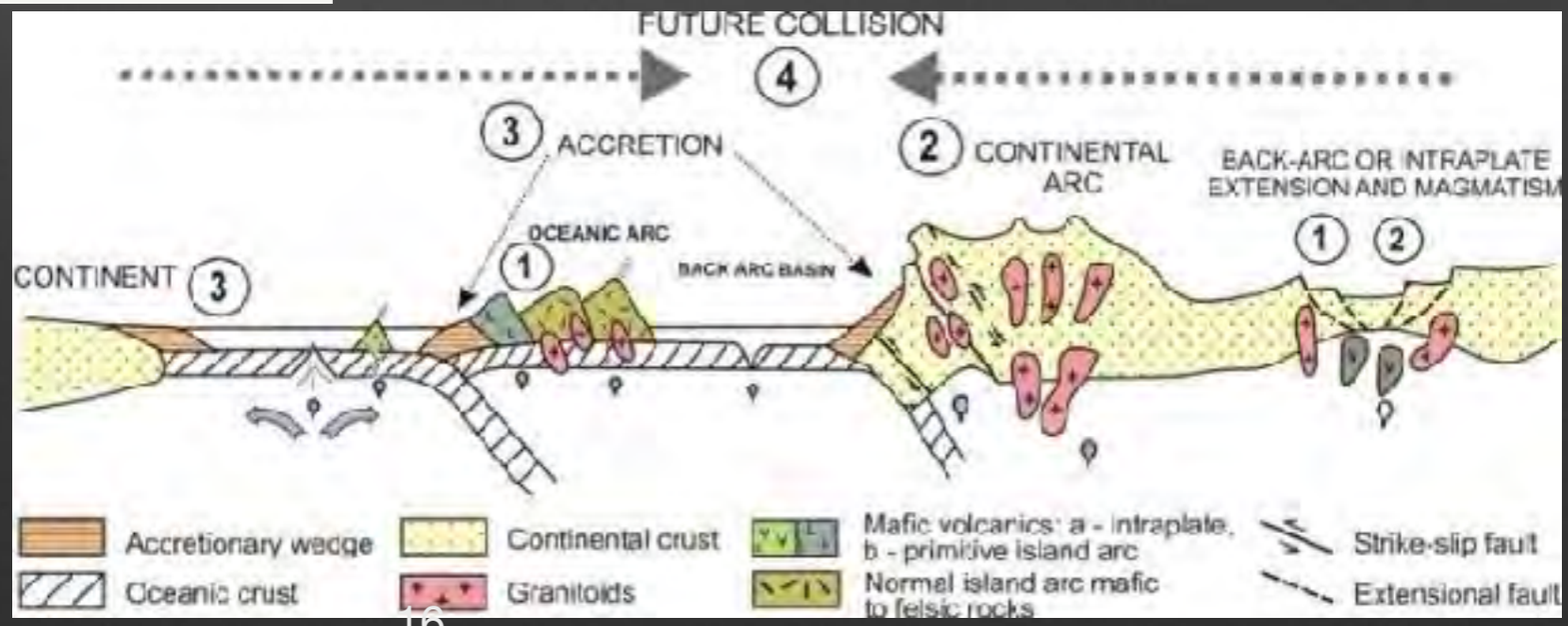

GEOLOGIC ZONATION OF THE TERRITORY OF MONGOLIA

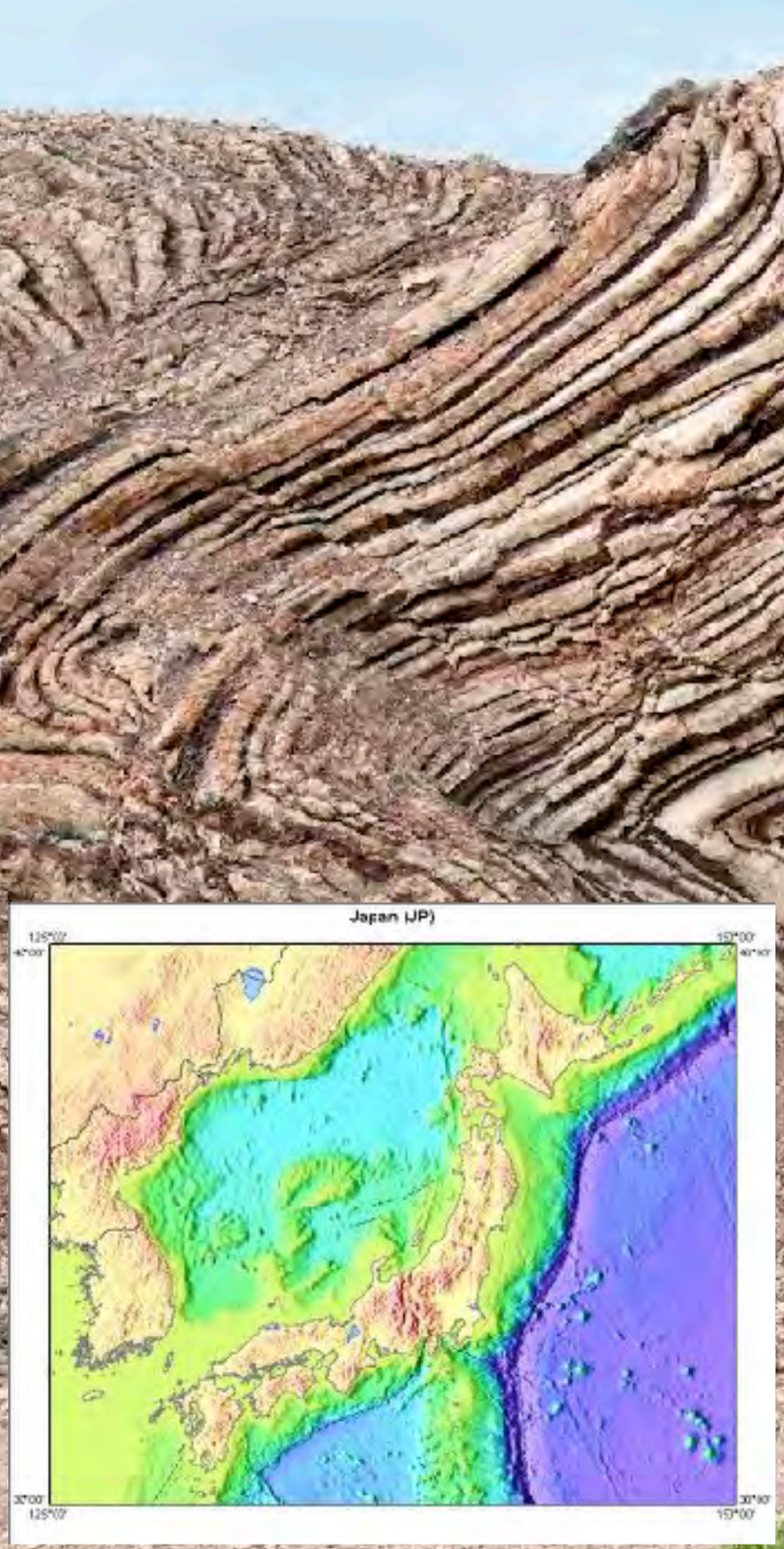

INDIAN OCEAN
NORTH PACIFIC OCEAN
GREAT SOUTHERN OCEAN
ANTARCTICA
ISLAND ARCS
SINGAPORE-ANTARCTICA


Global Distrubution of Active Marine Volcanic Arcs
60 N
20 N
20 S
60 S
20 E
60 E
100 E
140 E
180
140 W
100 W
60 W
20 W
Aleutian
West Aleutian
Izu
Bonin
Mariana
Luzon
Bicol
Sangihe
Halmahera
Bismarck
Solomons
Sunda
Banda
New Hebrides
Tonga
Kermadec
Peyegue
East Pacific
South Sandwich
Intra-oceanic arc
Island arc
Eastern Pacific MOR

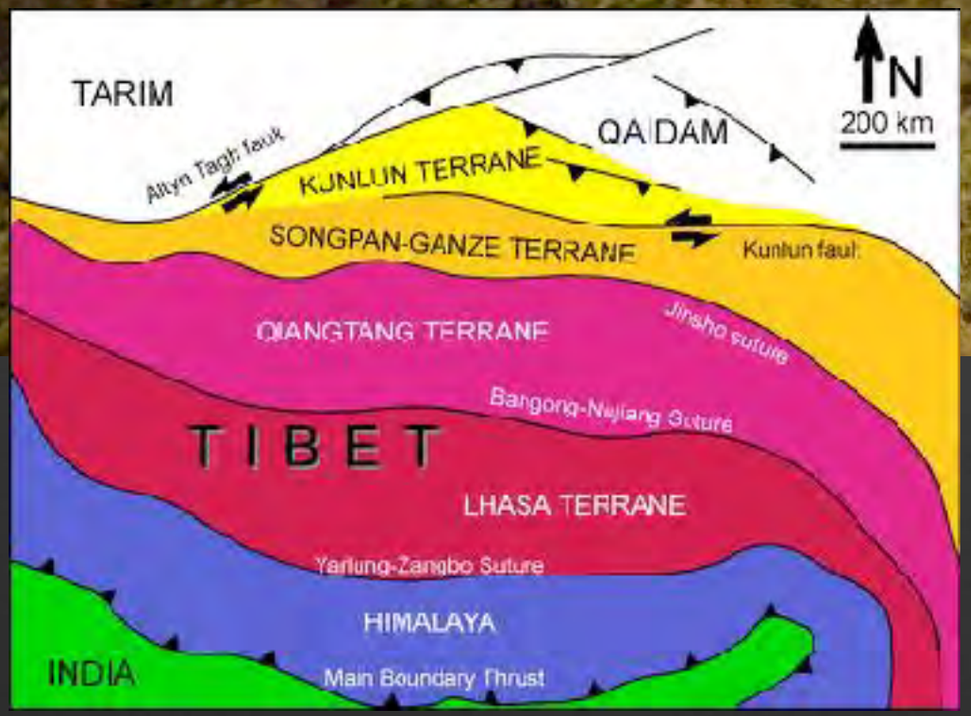

host continent
magmatic arc
accretionary complex
subducting slab
arc growth
migration of
frontal magmatism
growing
accretionary complex
host continent
retreating of
subducting slab
retreating of
subducting slab
continental growth
migration of
frontal magmatism
growing
accretionary complex
host continent
retreating of
subducting slab
retreating of
subducting slab


Formation of Back-arc Basin and Spreading
„Continental plate" as a whole
follows trench retreating
T1
T2
T3
Retreating of trench/subduction zone

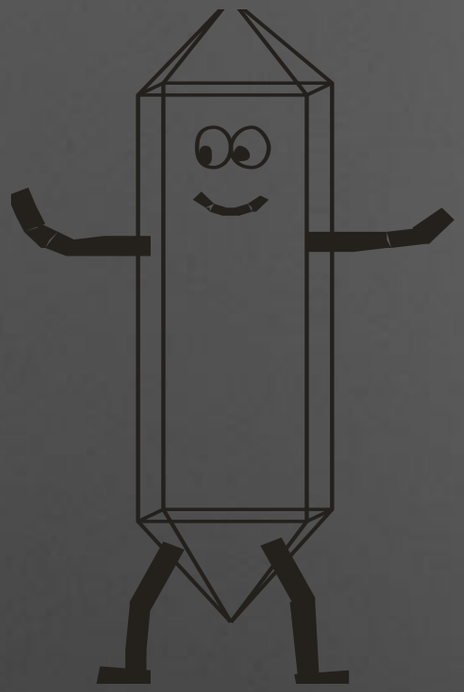

FUTURE COLLISION
4
3
ACCRETION
2
CONTINENTAL ARC
BACK-ARC OR INTRAPLATE EXTENSION AND MAGMATISM
OCEANIC ARC
1
BACK ARC BASIN
CONTINENT
3
1
2
Accretionary wedge
Oceanic crust
Continental crust
Granitoids
Mafic volcanics: a - intraplate, b - primitive island arc
Normal island arc mafic to felsic rocks
Strike-slip fault
Extensional fault

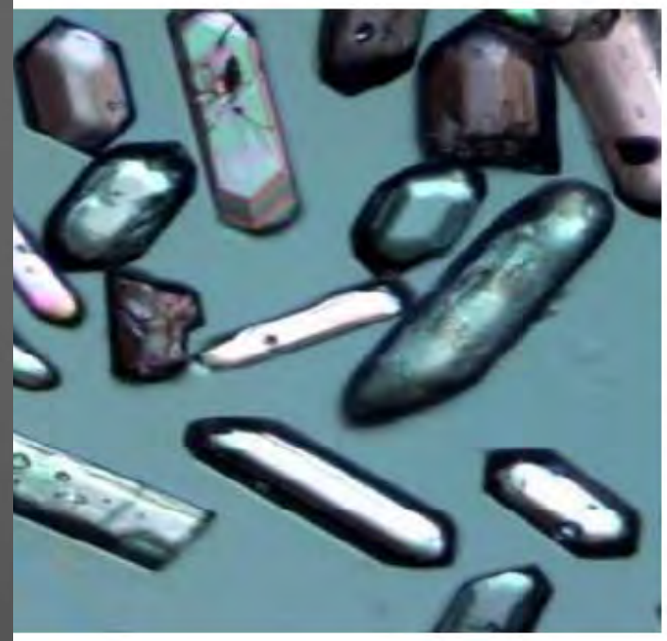

Japan (JP)
125°00'
150°00'
45°00'
30°00'
30°00'
125°00'
150°00'

Terrane collage

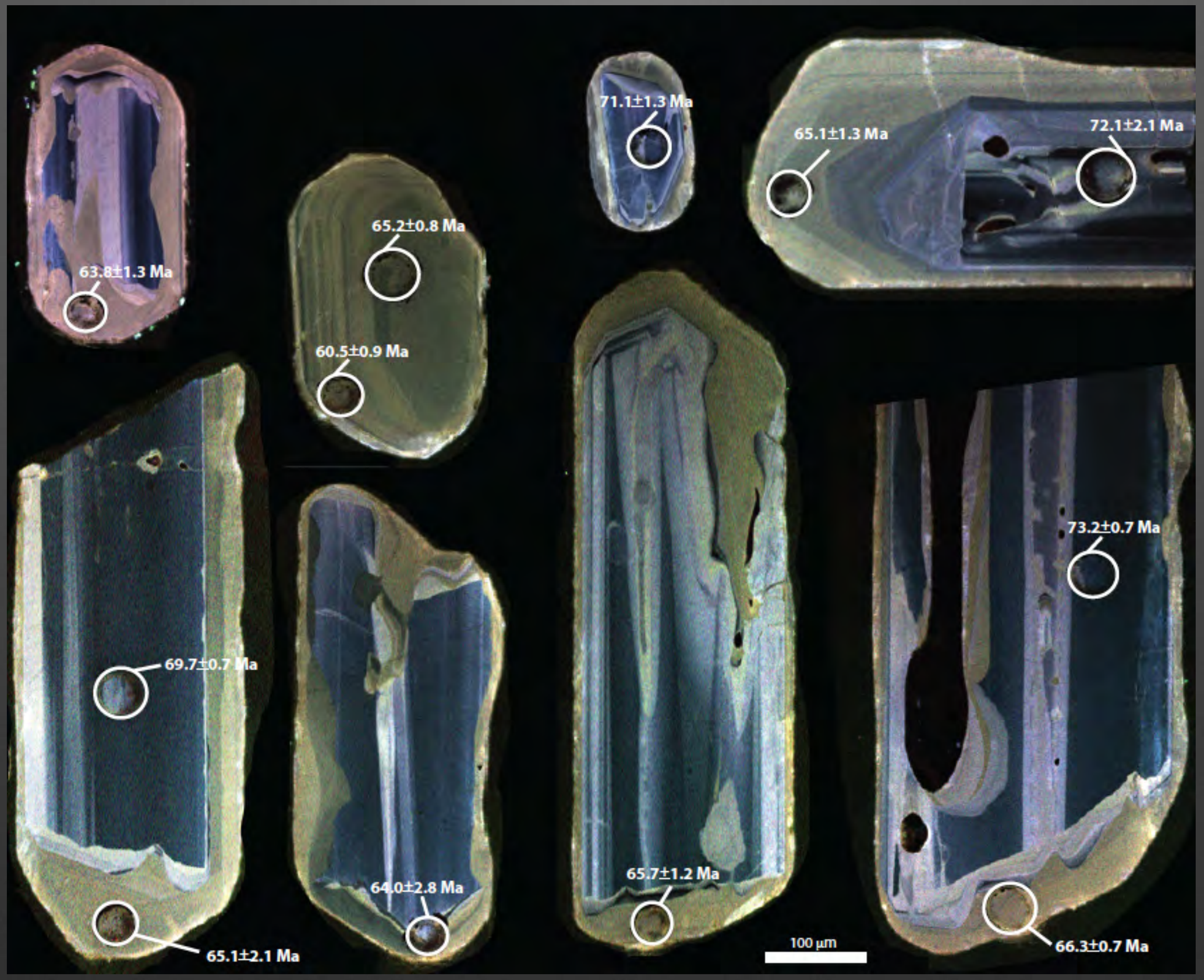



Philippine Sea
THAILAND
VIETNAM
Celebes Sea
INDONESIA



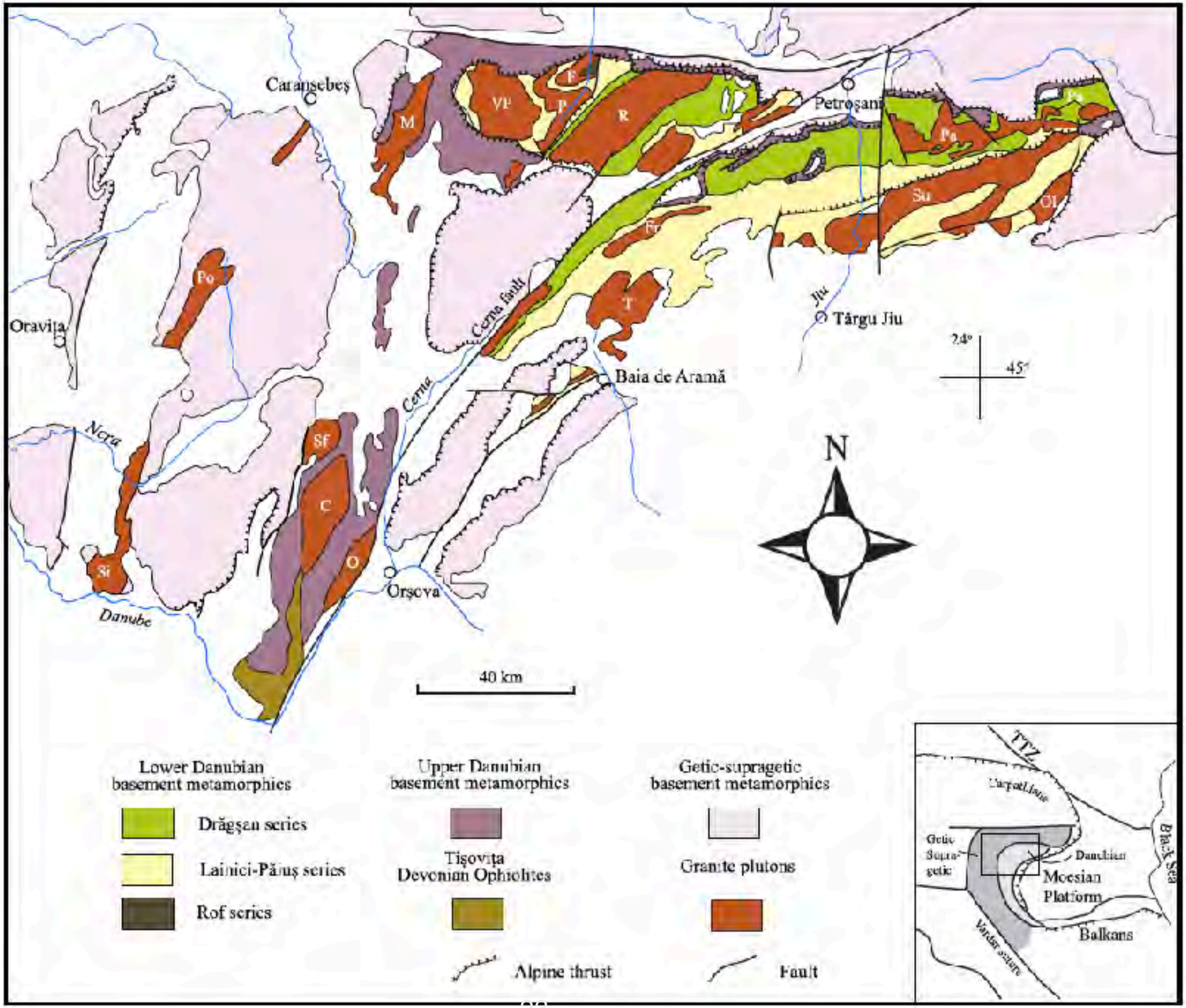


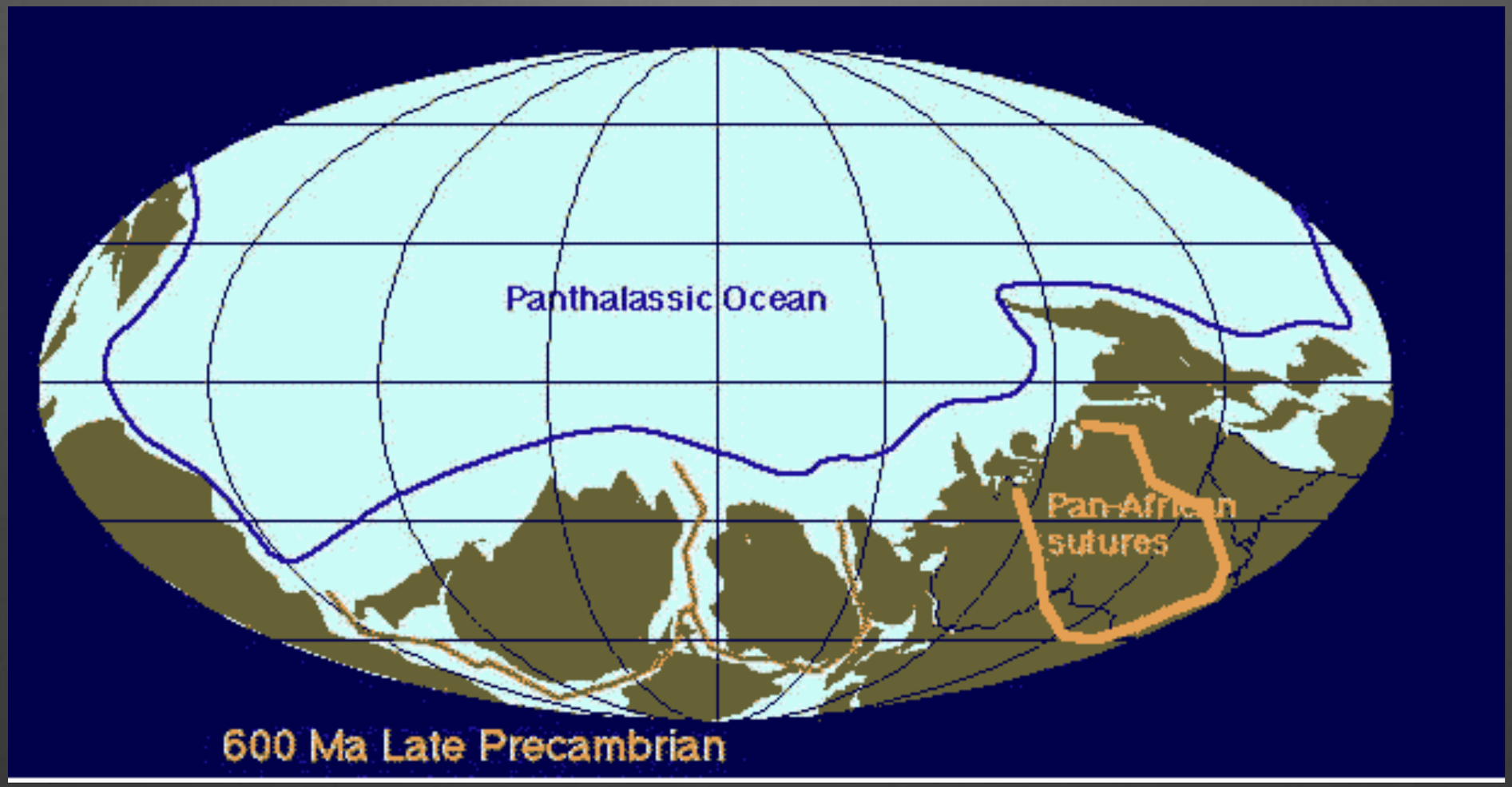
304 Ma
413 Ma
100 µm

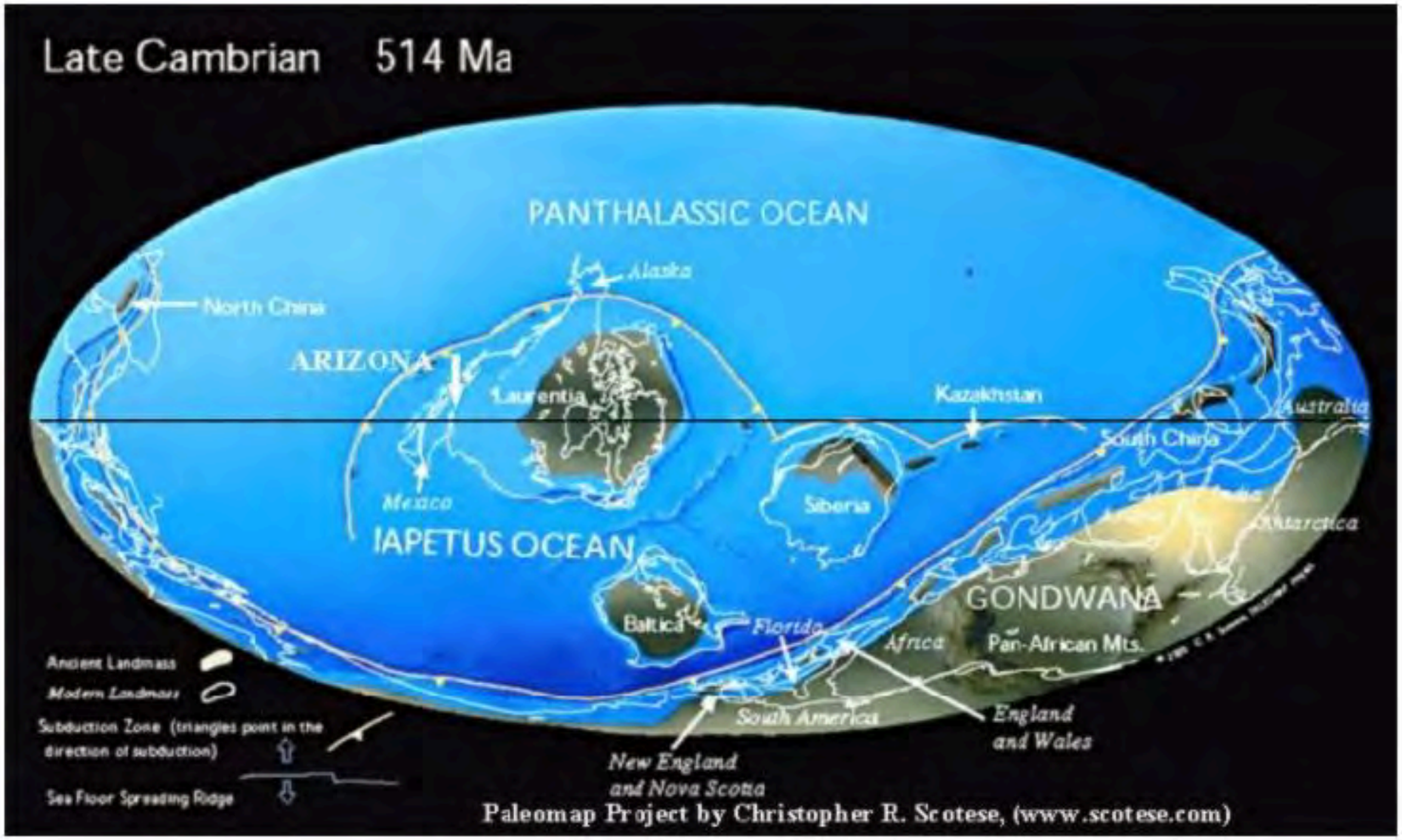

63.8±1.3 Ma
65.2±0.8 Ma
60.5±0.9 Ma
71.1±1.3 Ma
65.1±1.3 Ma
72.1±2.1 Ma
73.2±0.7 Ma
69.7±0.7 Ma
64.0±2.8 Ma
65.7±1.2 Ma
65.1±2.1 Ma
66.3±0.7 Ma
100 µm

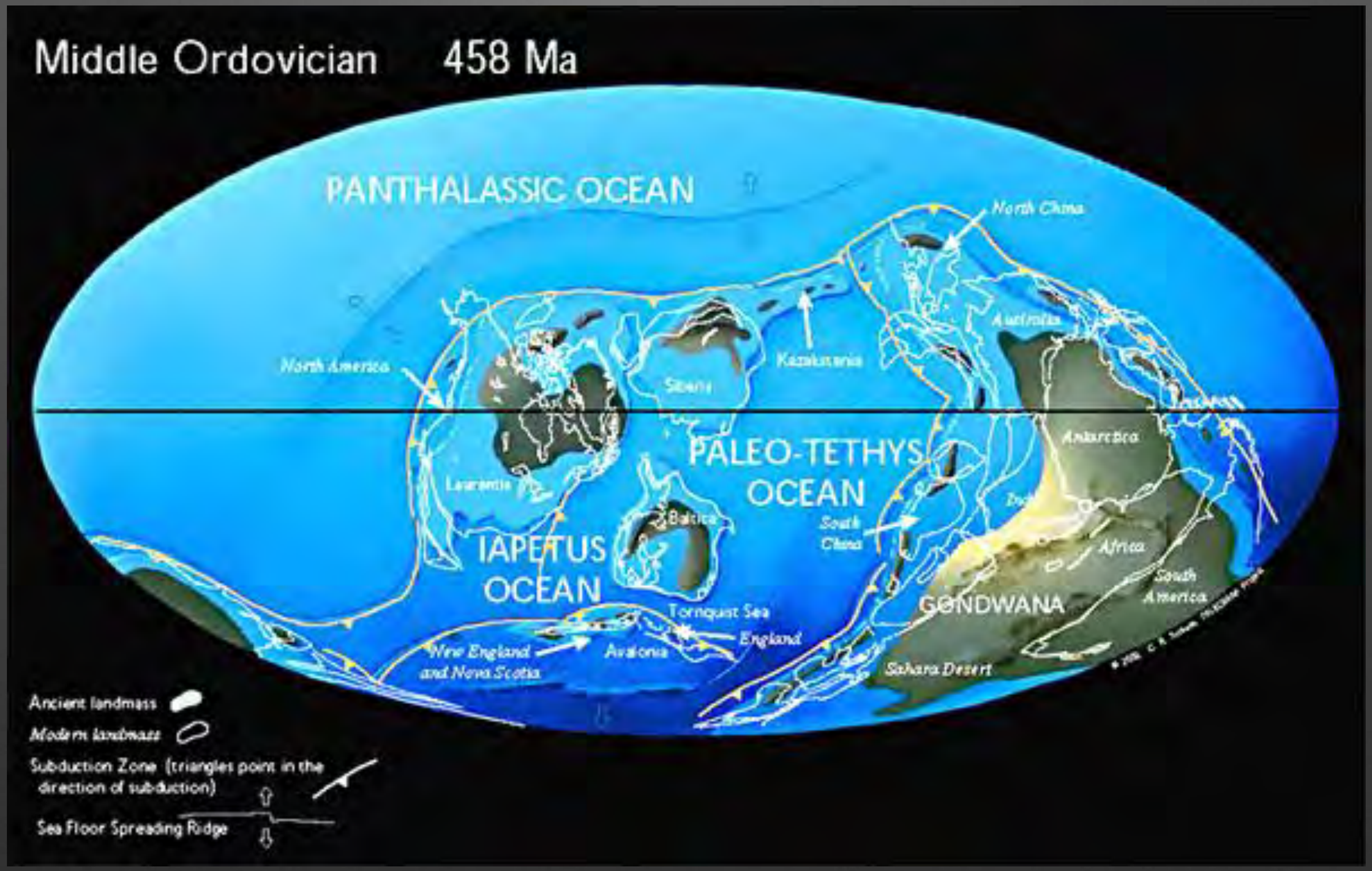
Carpathian basement ages

- Lower Danubian is the oldest - 800 Ma
- Everything else falls into the range of 560-420 igneous ages with inheritance
- 85% of the basement is Cambro Ordovician
- some late Variscan granitoids are yet to be resolved genetically (e.g. Retezat)
- most but not all basement appears metamorphosed post Ordovician


Caransebeș
Petroșani
Oravița
Baia de Aramă
Târgu Jiu
Orșova
Cerna fault
Cerna
Nera
Danube
Jiu
24°
45°
N
40 km
Lower Danubian basement metamorphics
Drăgșan series
Lainici-Păiuș series
Rof series
Upper Danubian basement metamorphics
Tișovița Devonian Ophiolites
Alpine thrust
Getic-supragetic basement metamorphics
Granite plutons
Fault
TTZ
Carpathians
Black Sea
Getic
Supra-getic
Danubian
Moesian Platform
Balkans
Vardar suture

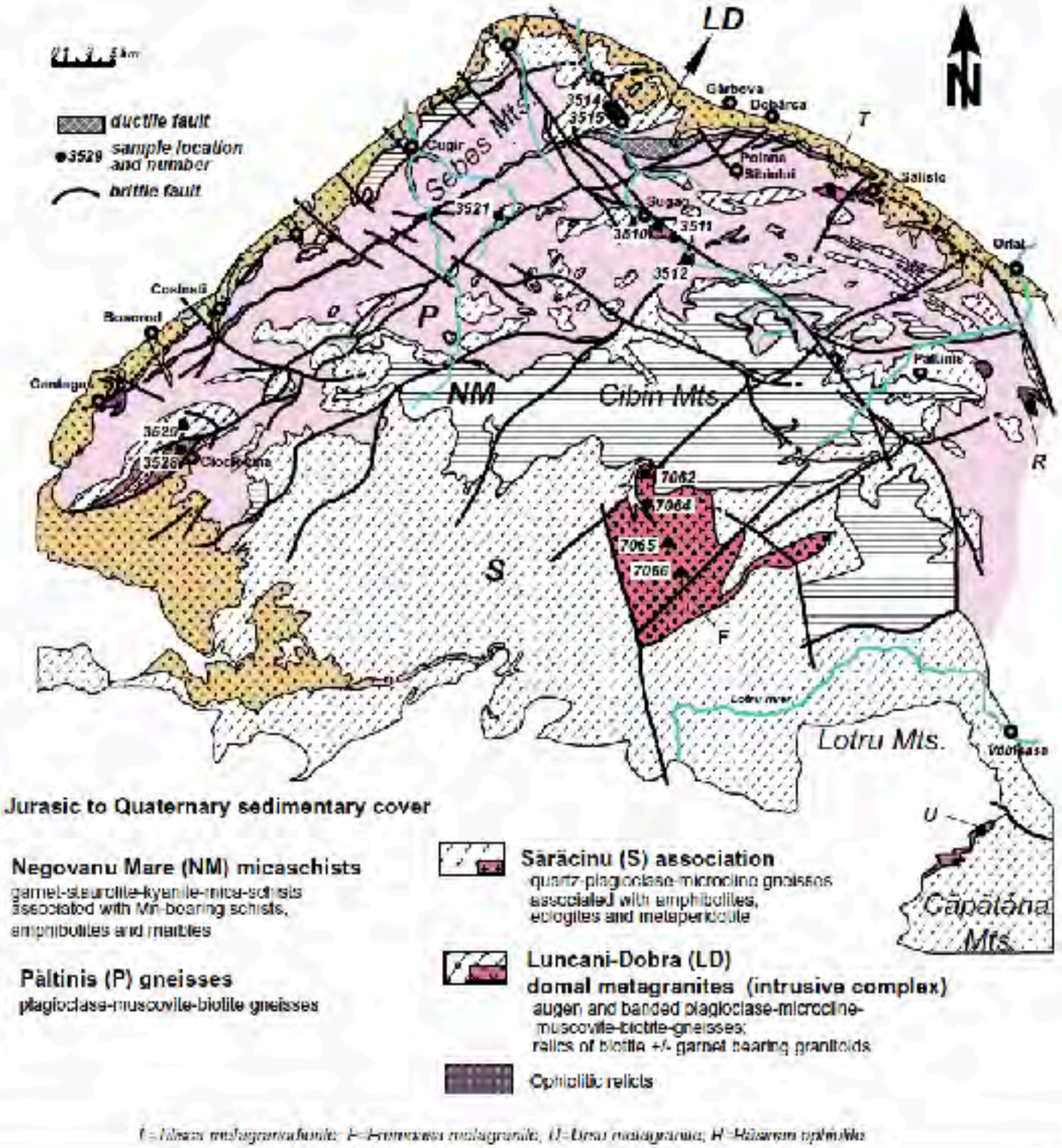

Panthalassic Ocean
Pan-African
sutures
600 Ma Late Precambrian

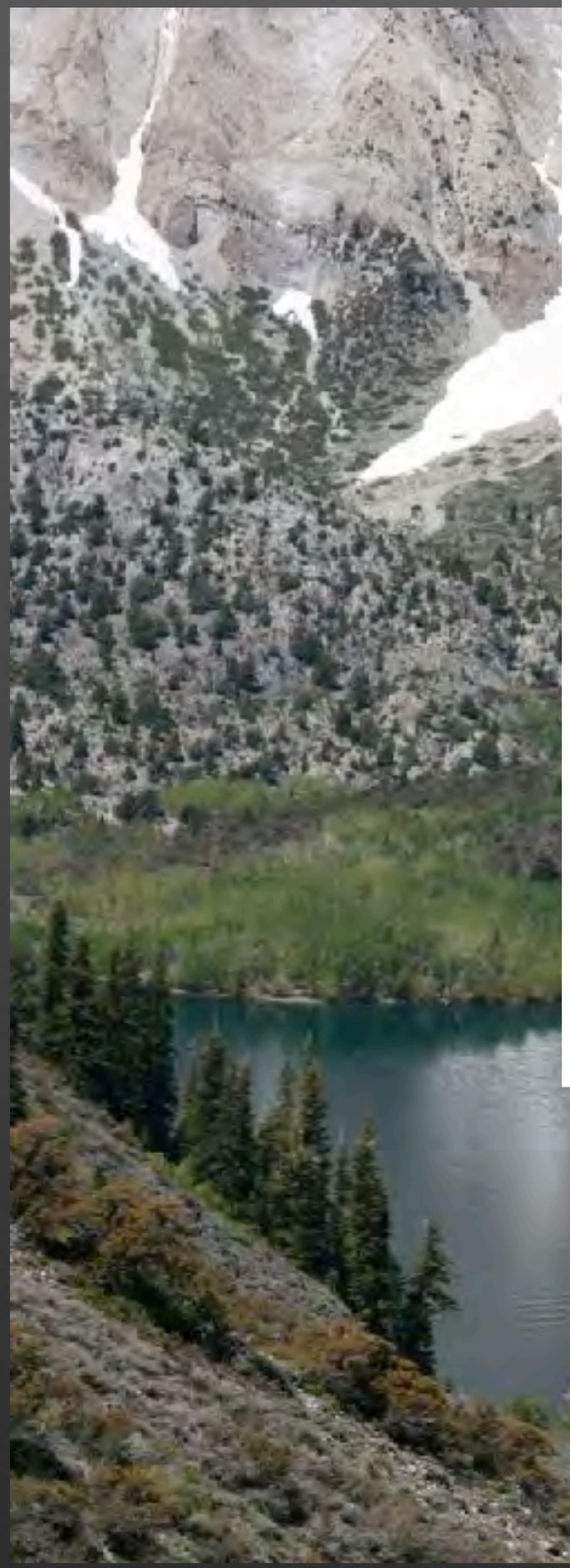

Late Cambrian 514 Ma
PANTHALASSIC OCEAN
Alaska
North China
ARIZONA
Laurentia
Kazakhstan
Australia
South China
Mexico
Siberia
Antarctica
IAPETUS OCEAN
GONDWANA
Baltica
Florida
Africa
Pan-African Mts.
South America
England and Wales
New England and Nova Scotia
Ancient Landmass
Modern Landmass
Subduction Zone (triangles point in the direction of subduction)
Sea Floor Spreading Ridge
Paleomap Project by Christopher R. Scotese, (www.scotese.com)

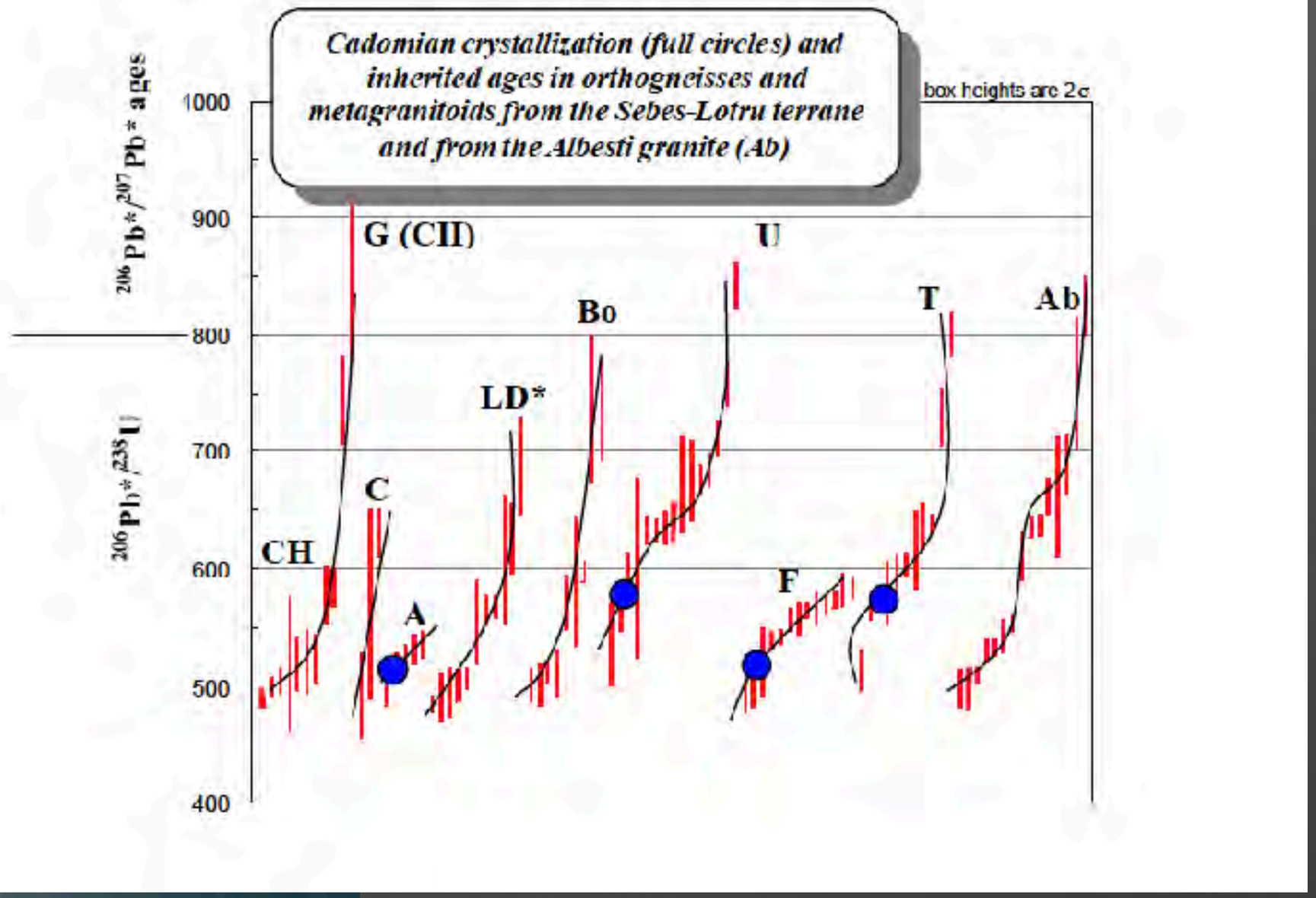

Middle Ordovician 458 Ma
PANTHALASSIC OCEAN
North China
Kazakstania
North America
Siberia
Australia
Laurentia
PALEO-TETHYS OCEAN
Antarctica
Baltica
South China
IAPETUS OCEAN
Africa
South America
GONDWANA
Tornquist Sea
England
New England and Nova Scotia
Avalonia
Sahara Desert
Ancient landmass
Modern landmass
Subduction Zone (triangles point in the direction of subduction)
Sea Floor Spreading Ridge

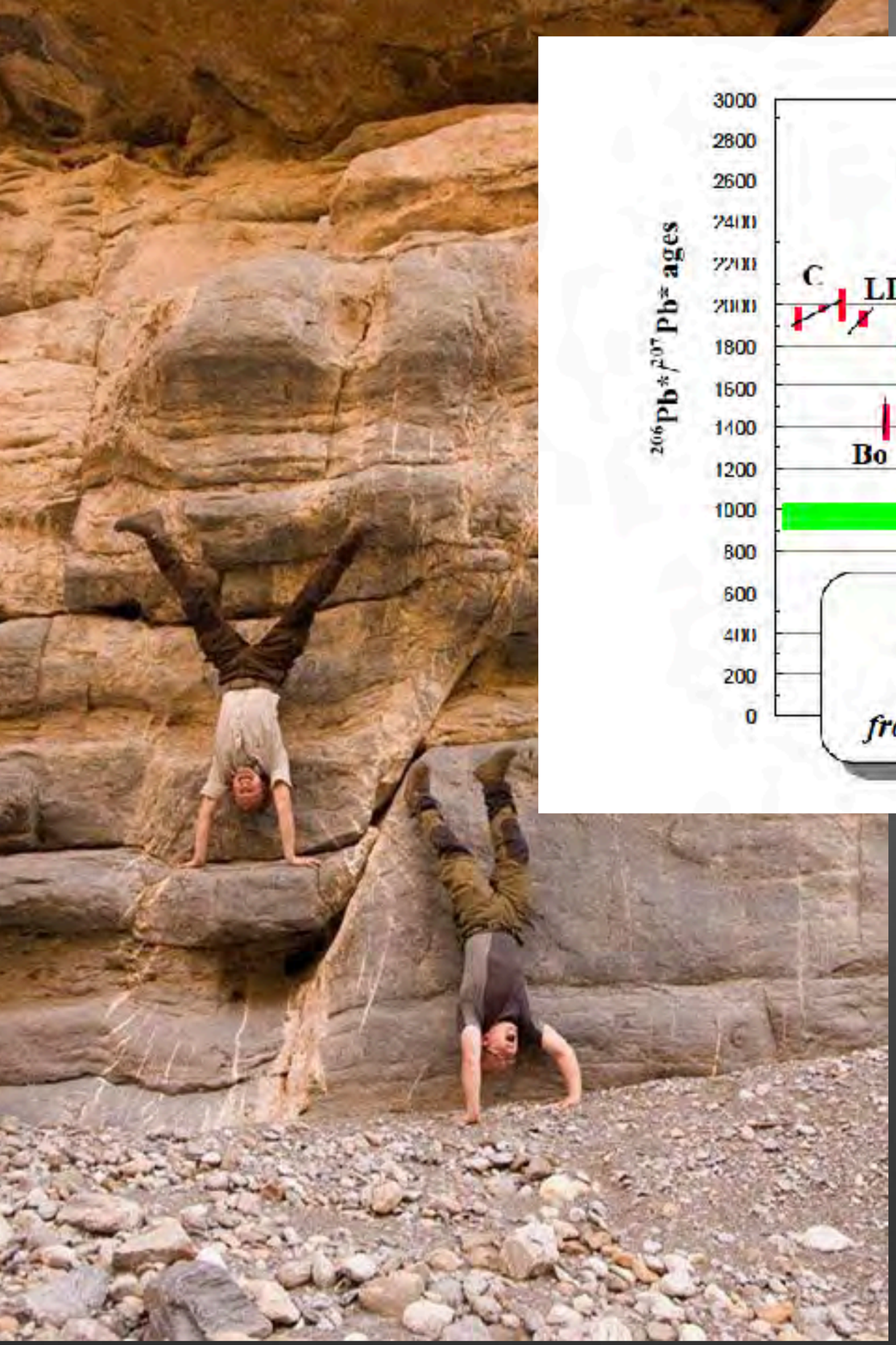
Geological map of the Sebes-Cibin Mountains with main lithology of the Sebes-Lotru terrane and samples location

(after Stelea, I., 1999, modified according to Sabau, 1994, Sabau and Massonc, 2003 and Geological Map of Romania scale 1:200 000, Orastie sheet)






Cadomian crystallization (full circles) and inherited ages in orthogneisses and metagranitoids from the Sebes-Lotru terrane and from the Albesti granite (Ab)
box heights are 2σ
$^{206}Pb^*/^{207}Pb^*$ ages
$^{206}Pb^*/^{238}U$
1000
900
800
700
600
500
400
G (CII)
U
Bo
T
Ab
LD*
C
CH
A
F



box heights are 2σ

$^{206}Pb^*/^{207}Pb^*$ ages

3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0

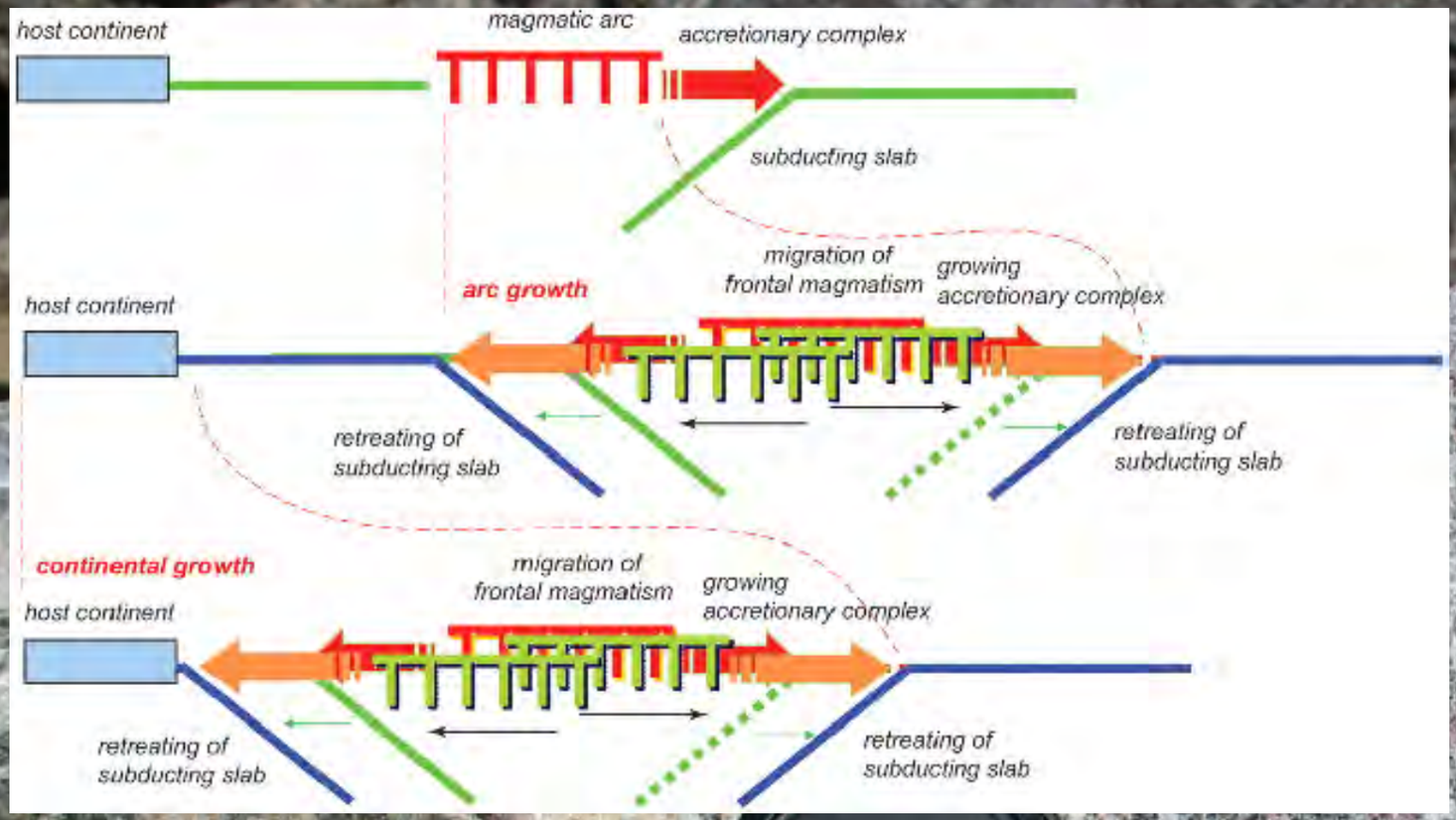
Bo
U
T
Ab
C
LD
U
Bo
T
Ab
Bo
U
T
Ab

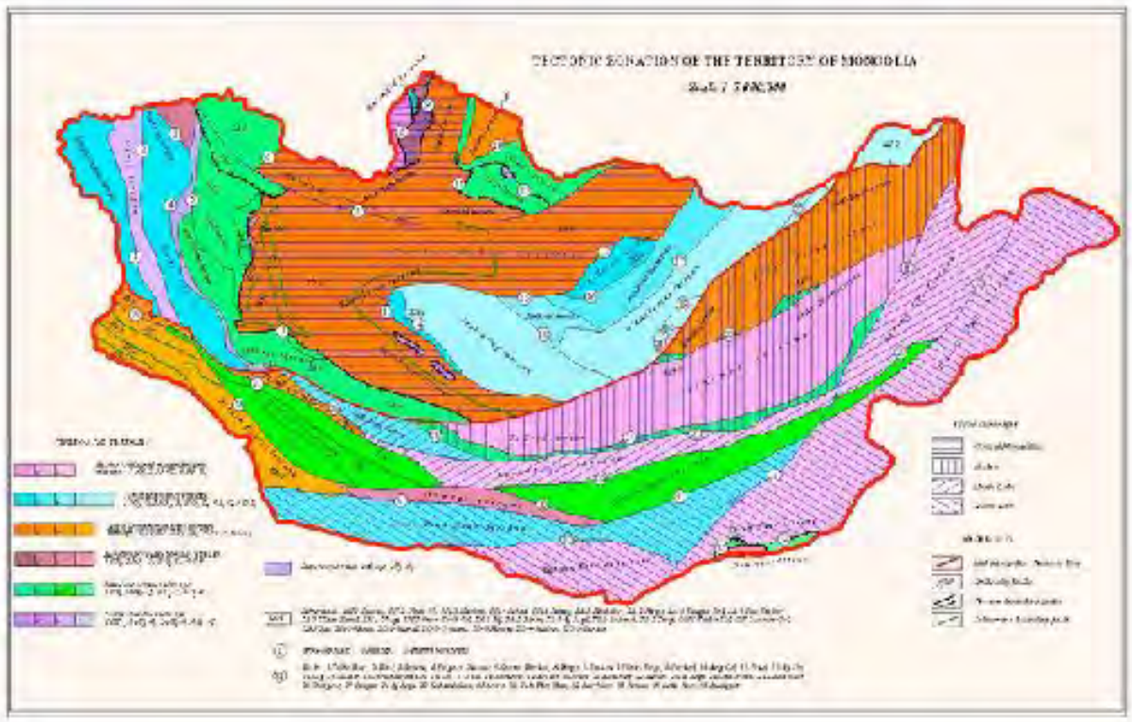
No ages between 0.9 – 1.1 Ga

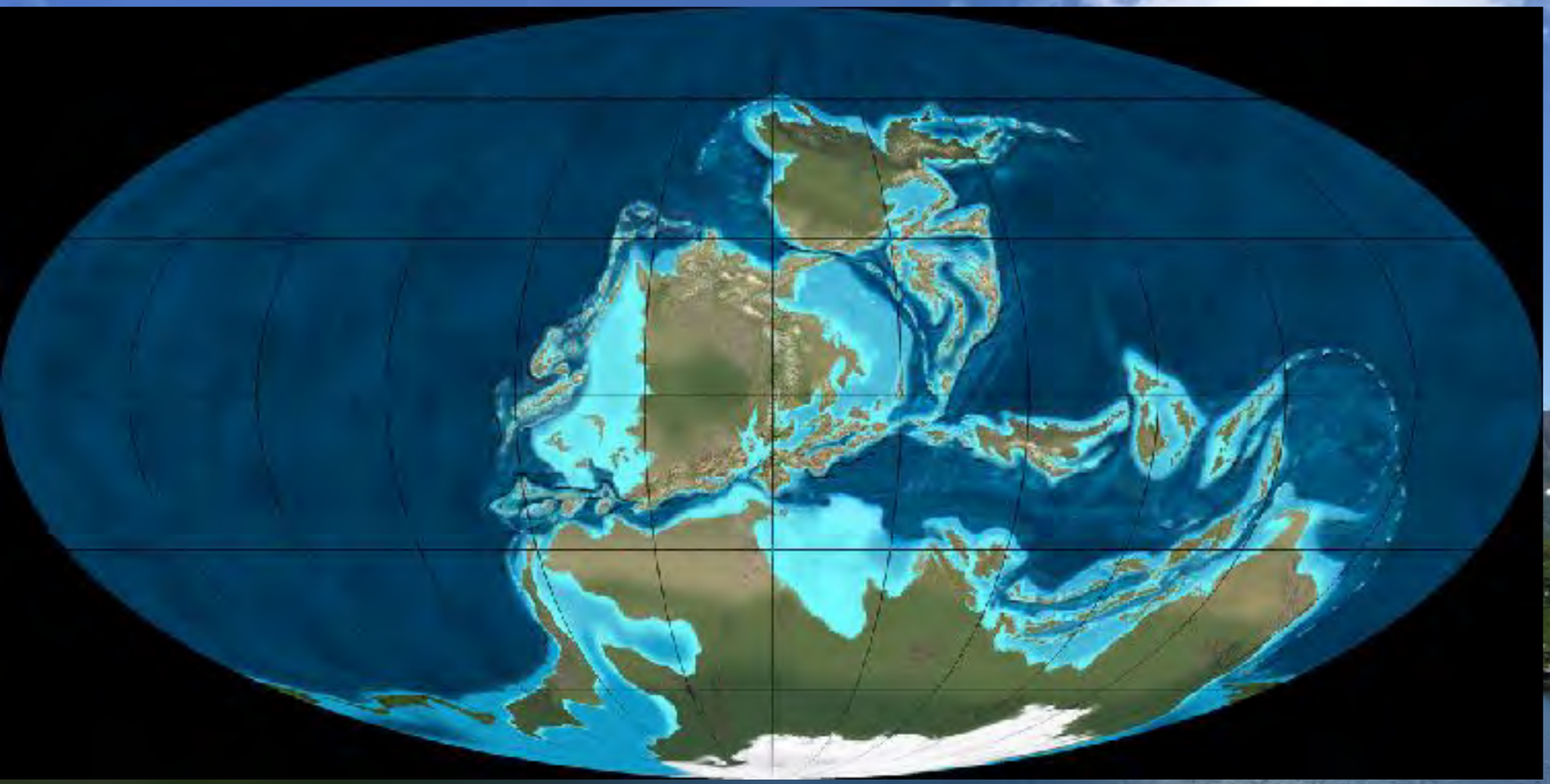
Pre-Cadomian inherited ages in orthogneisses and metagranitoids from the Sebes-Lotru terrane and from the Albesti granite (Bughea suture)

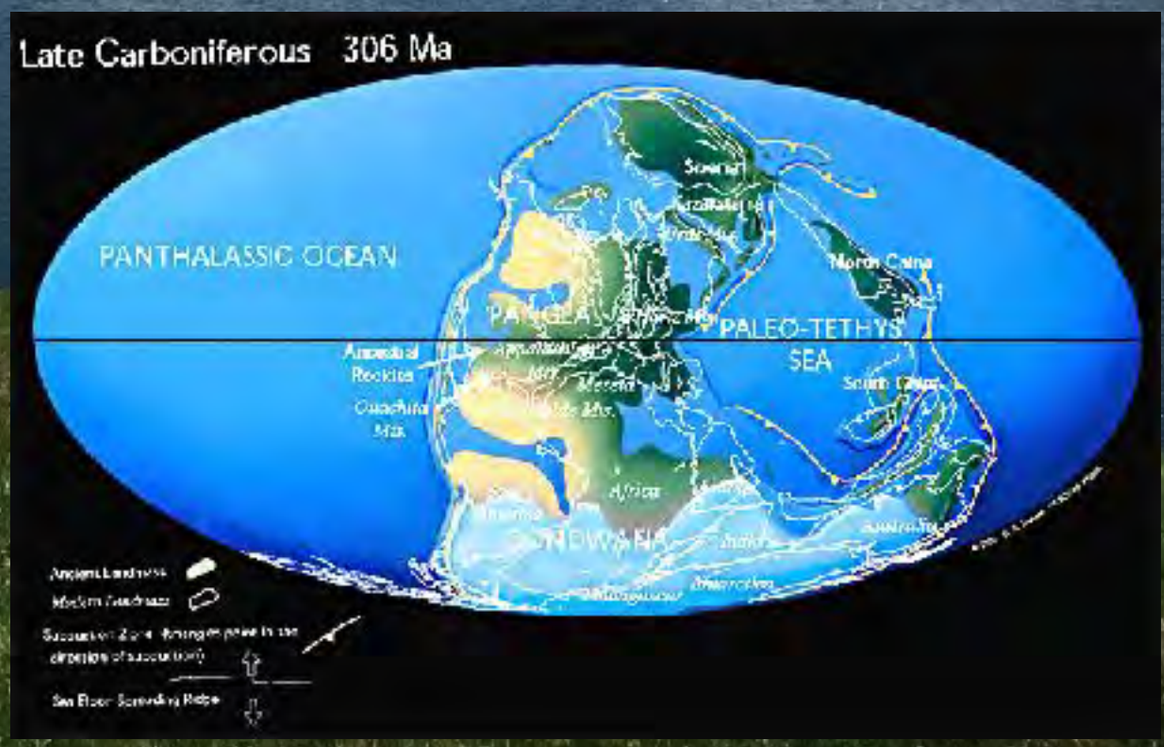
Age of the big bang?

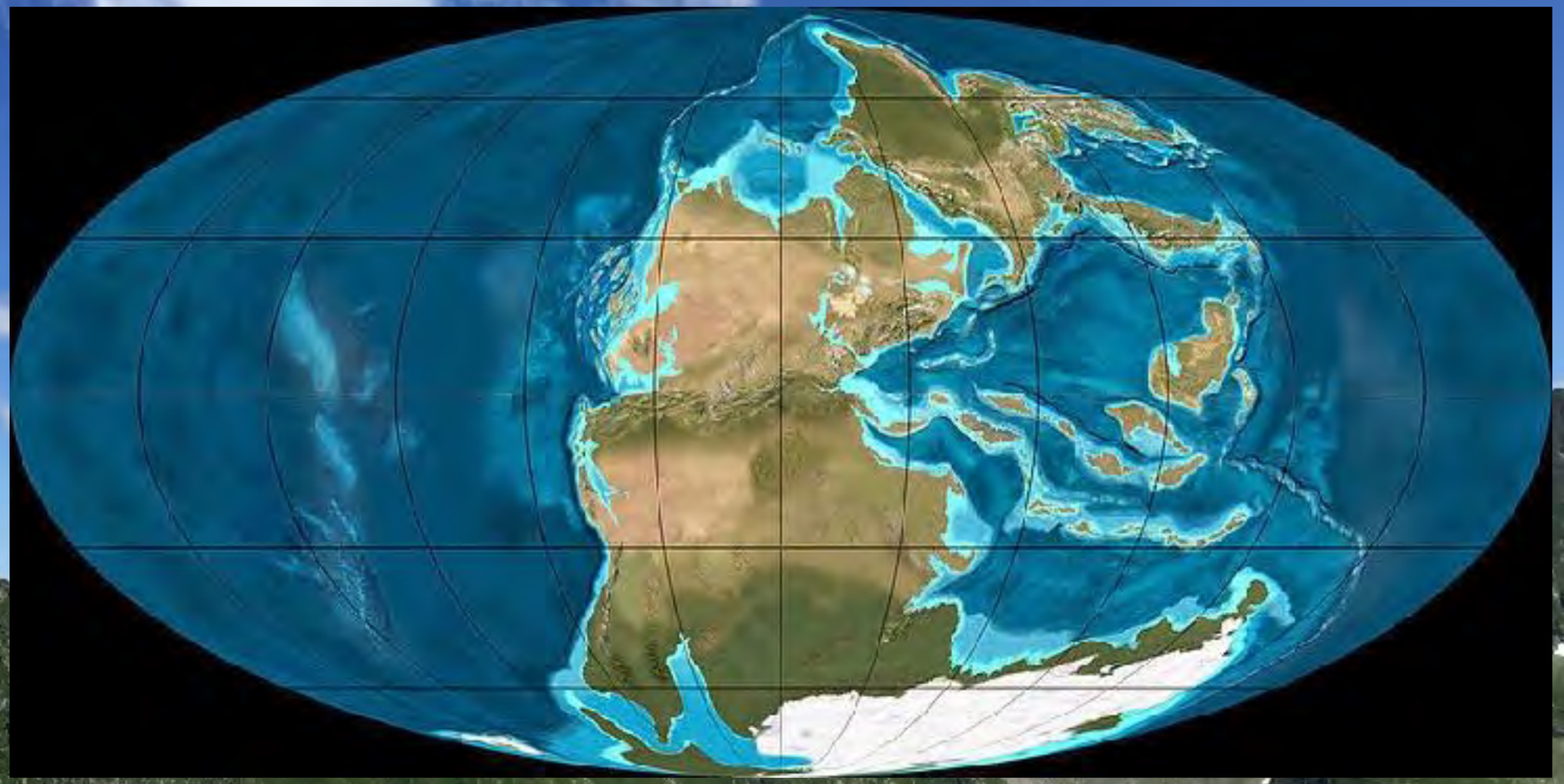
- Not all metamorphic terrains have the evidence for this hard collision
- The high grade terrains do; the biggest of them is the Sebes Lotru unit in the South Carpathians;
- Think Fagaras metamorphic rocks
- and think Himalayan style collision
- It took place between 350-325 Ma and it was followed by extensional collapse

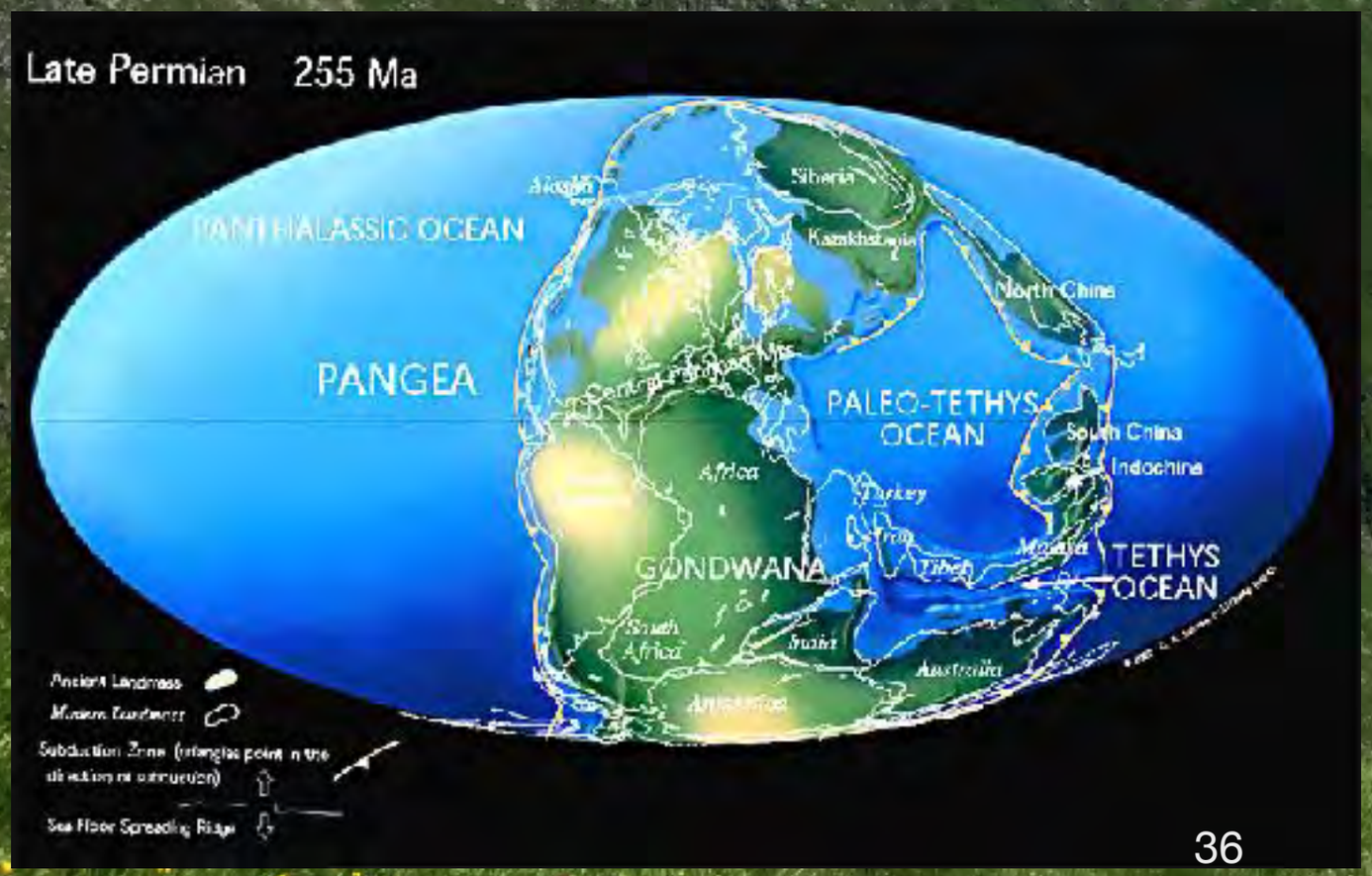

host continent
magmatic arc
accretionary complex
subducting slab
migration of
frontal magmatism
growing
accretionary complex
arc growth
host continent
retreating of
subducting slab
retreating of
subducting slab
continental growth
migration of
frontal magmatism
growing
accretionary complex
host continent
retreating of
subducting slab
retreating of
subducting slab

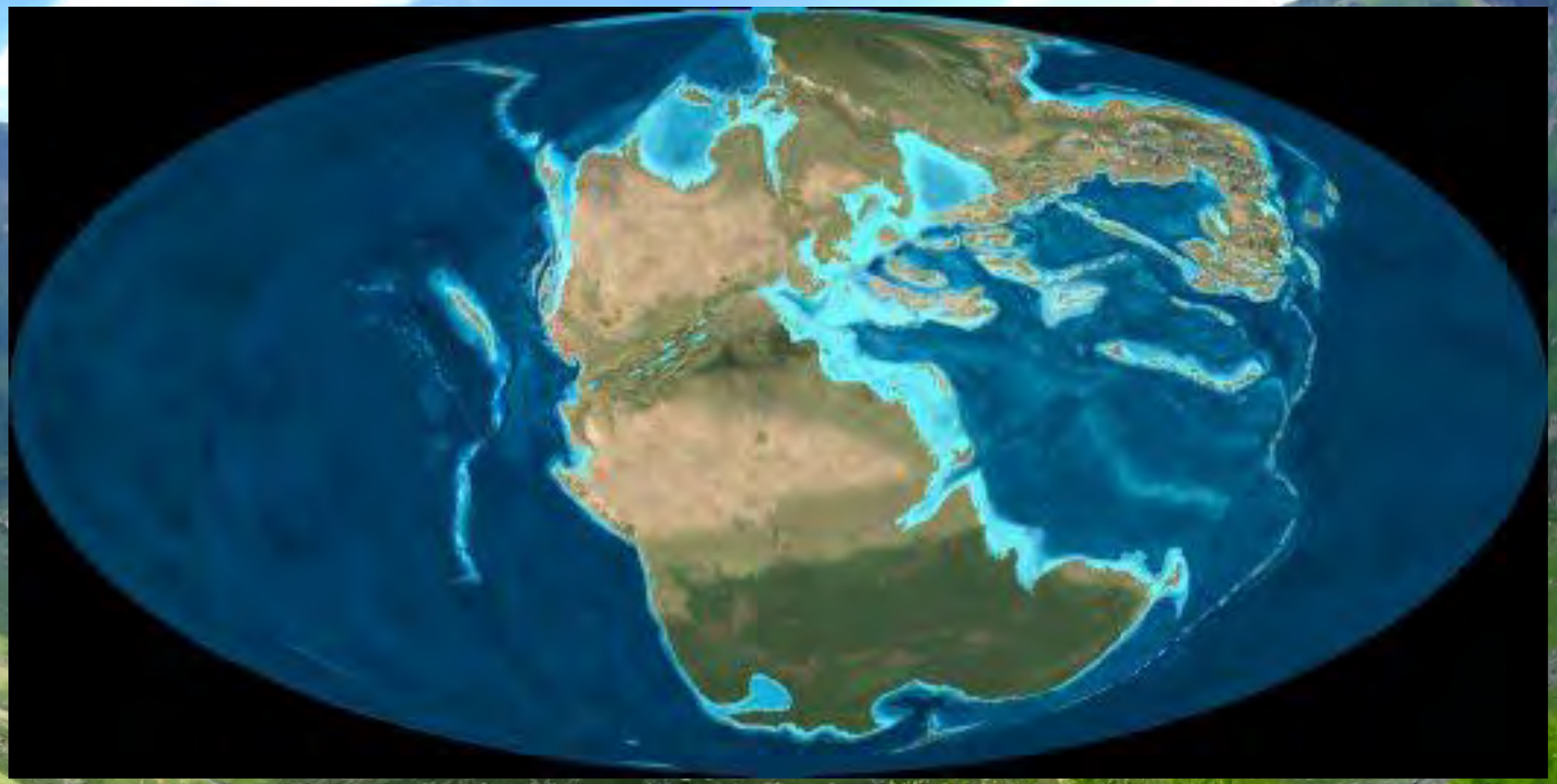





Late Carboniferous 306 Ma
PANTHALASSIC OCEAN
PANGEA
PALEO-TETHYS
SEA
North China
Ancestral Rockies
Ouachita Mts.
Africa
GONDWANA



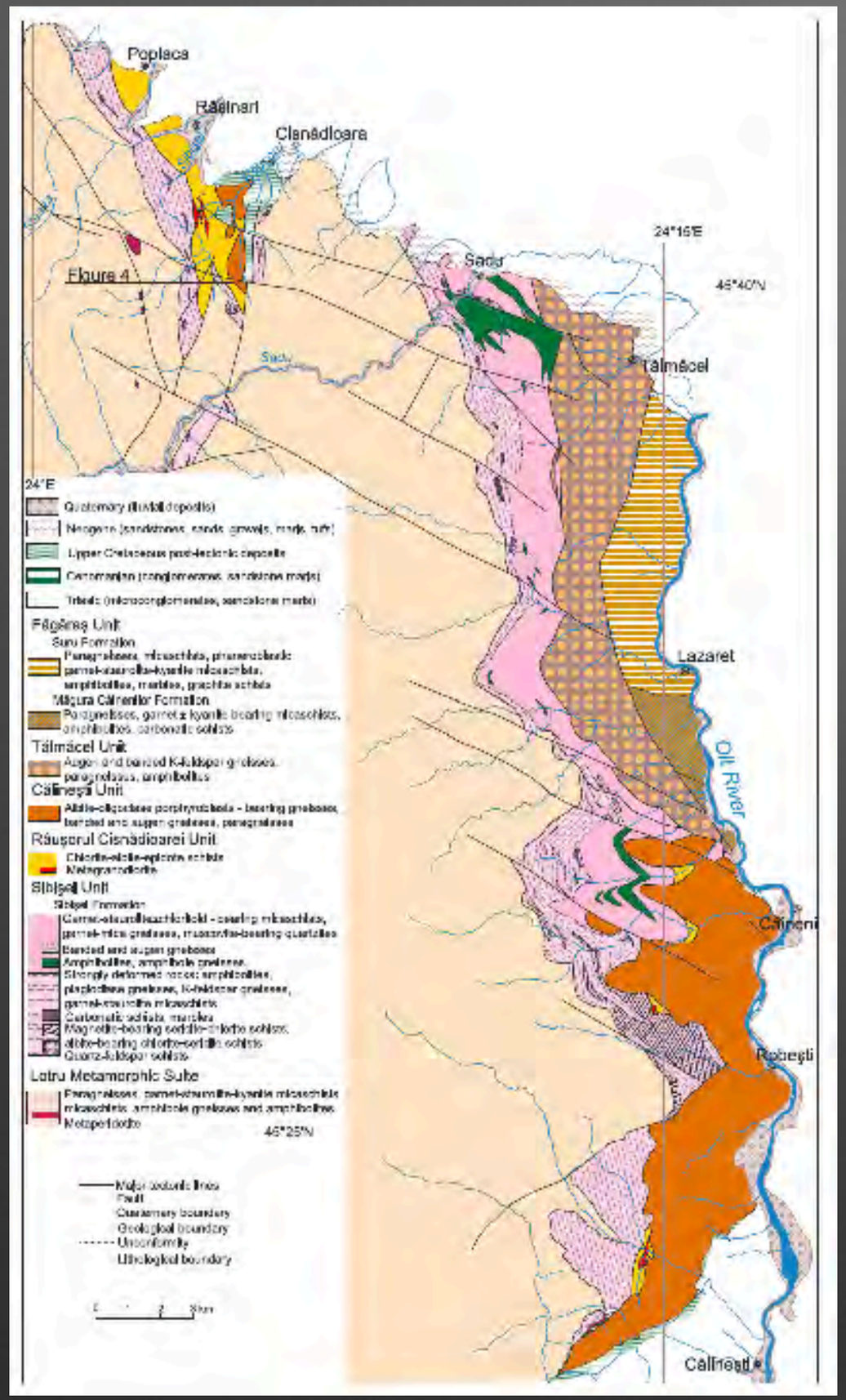

Late Permian 255 Ma
PANTHALASSIC OCEAN
PANGEA
Siberia
Kazakhstan
North China
PALEO-TETHYS OCEAN
South China
Indochina
Africa
Turkey
Iran
Tibet
Malaya
TETHYS OCEAN
GONDWANA
South Africa
India
Australia
Antarctica
Ancient Landmass
Modern Landmass
Subduction Zone (triangles point in the direction of subduction)
Sea Floor Spreading Ridge

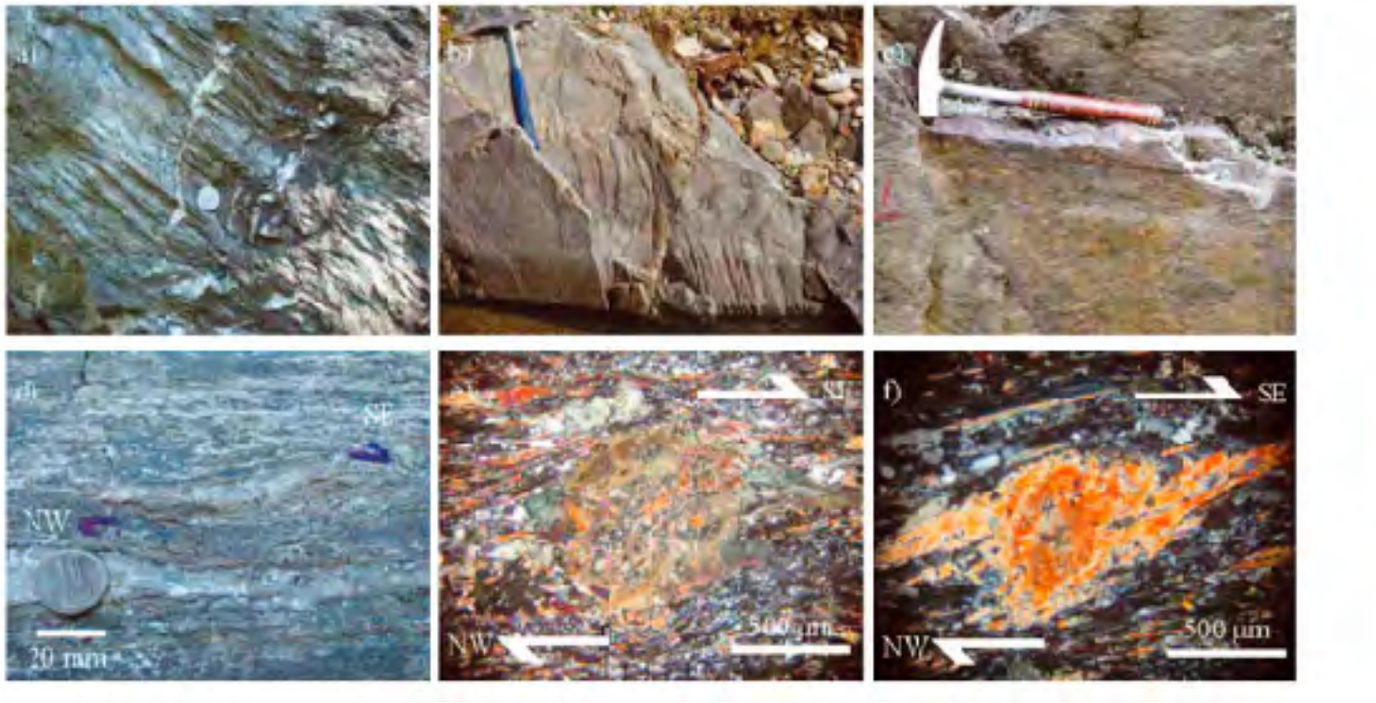


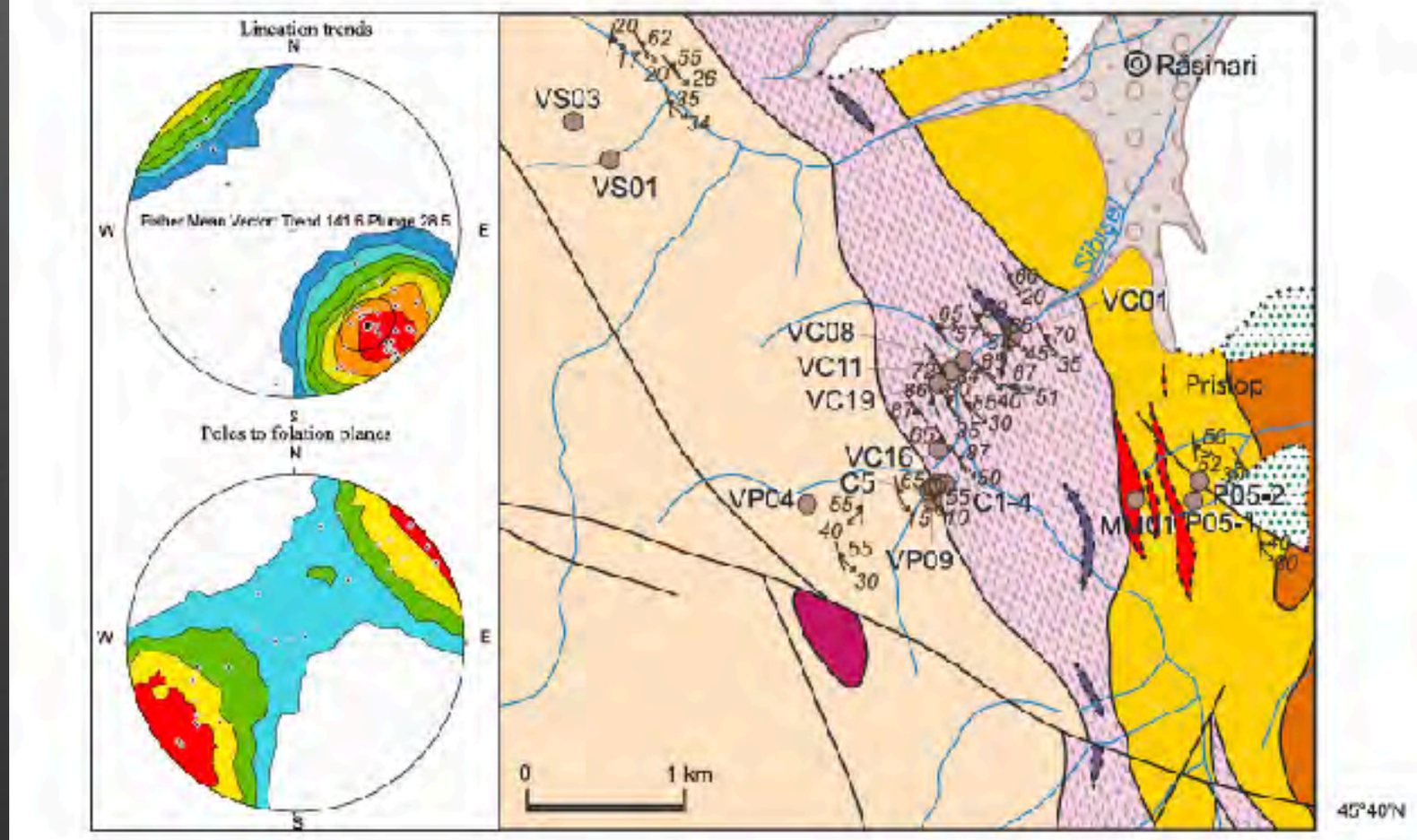

Early Triassic 237 Ma
PANTHALASSIC OCEAN
PALEO-TETHYS OCEAN
PANGEA
TETHYS OCEAN

Example- Rasinari

- Major shear zone
- puts in contact 2 different types of metamorphic assemblages, on high grade and another one low grade
- Both are island arc terranes with Cambro Ordovician ages
- They were attached to each other across an oceanic-like material in the Permian
- Only one (the high grade) had Variscan collisional (big bang) metamorphism
- The other has been floating across the paleo-tethys until its ultimate collision in the Permian, possibly even the early Triassic


Poplaca
Răetnari
Cisnădioara
24°16'E
Sadu
45°40'N
Figure 4
Sadu
Tălmăcel
24°E
Quaternary (fluvial deposits)
Neogene (sandstones, sands, gravels, marls, tuff)
Upper Cretaceous post-tectonic deposits
Cenomanian (conglomerates, sandstones marls)
Triassic (microconglomerates, sandstones marbs)
Făgăraș Unit
Sadu Formation
Paragneisses, micaschists, plurimetabasic garnet-staurolite-kyanite micaschists, amphibolites, marbles, graphite schists
Măgura Cărnenilor Formation
Paragneisses, garnet ± kyanite bearing micaschists, amphibolites, carbonatic schists
Tălmăcel Unit
Augen and banded K-feldspar gneisses, paragneisses, amphibolites
Călineşti Unit
Albite-oligoclase porphyroblasts - bearing gneisses, banded and augen gneisses, paragneisses
Răuşorul Cisnădioarei Unit
Chlorite-sericite-epidote schists
Metagranodiorite
Sibişel Unit
Sibişel Formation
Garnet-staurolite±kyanite - bearing micaschists, garnet-mica gneisses, muscovite-bearing quartzites
Banded and augen gneisses
Amphibolites, amphibolite gneisses
Strongly deformed rocks: amphibolites, plagioclase gneisses, K-feldspar gneisses, garnet-staurolite micaschists
Carbonatic schists, marbles
Magnetite-bearing sericite-chlorite schists, albite-bearing chlorite-sericite schists
Quartz-feldspar schists
Lotru Metamorphic Suite
Paragneisses, garnet-staurolite-kyanite micaschists micaschists, amphibolite gneisses and amphibolites
Metaperidotite
45°35'N
Major tectonic lines
Fault
Cretaceous boundary
Geological boundary
Unconformity
Lithological boundary
Oit River
Cărnenii
Poienești
Călinești


NE
NW
20 mm
NW
500 μm
SE
NW
500 μm


Lineation trends
N
W
E
S
Fisher Mean Vector: Trend 141.6 Plunge 28.5
Poles to foliation planes
N
W
E
S
VS03
VS01
VC08
VC11
VC19
VC16
C5
VP04
VP09
C1-4
VC01
Pristop
P05-2
P05-1
Rasinari
Sibiel
0
1 km
45°40'N
24°15'E

Summary

- The basement formed as volcanic arcs and marginal basins outboard of paleo Africa and collided with the east European cartoon in late Paleozoic as the Paleo Tethys ocean and its variants were closing. Some units underwent HARD others SOFT collisions.

The Alpine story

- We were near but not at the real margin of the Tethys ocean (Mesozoic - to Cenozoic) and saw the development of back arc basins, maybe the main arc of the late Jurassic -early Cretaceous

- The back arc basins - a segment closed and made the South Carpathians, the rest evolved into a large marginal back arc basin known as the Paratethys

- The Paratethys closed in the East Carpathian (Miocene and younger) but continues to exist east in the Black Sea

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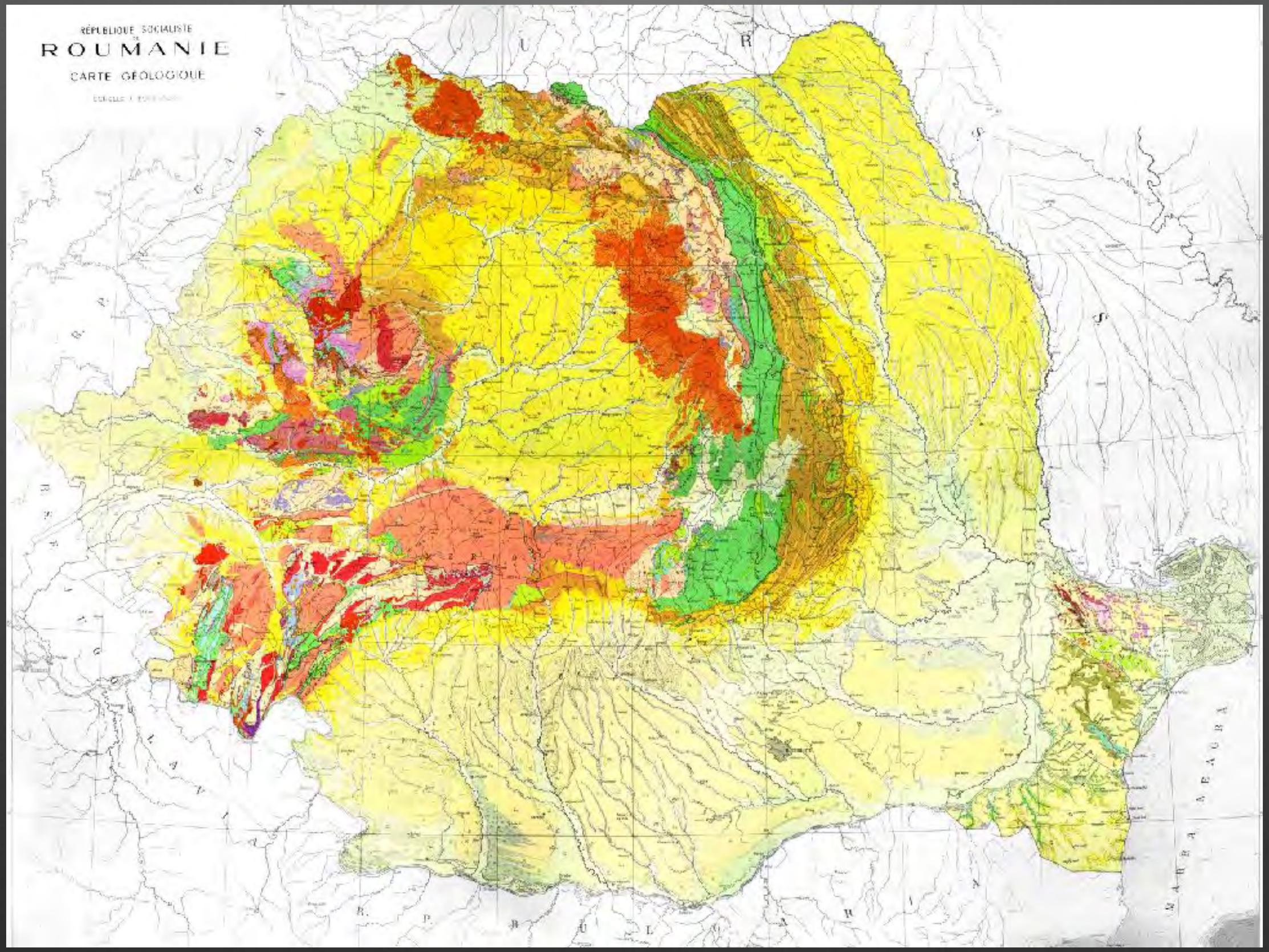
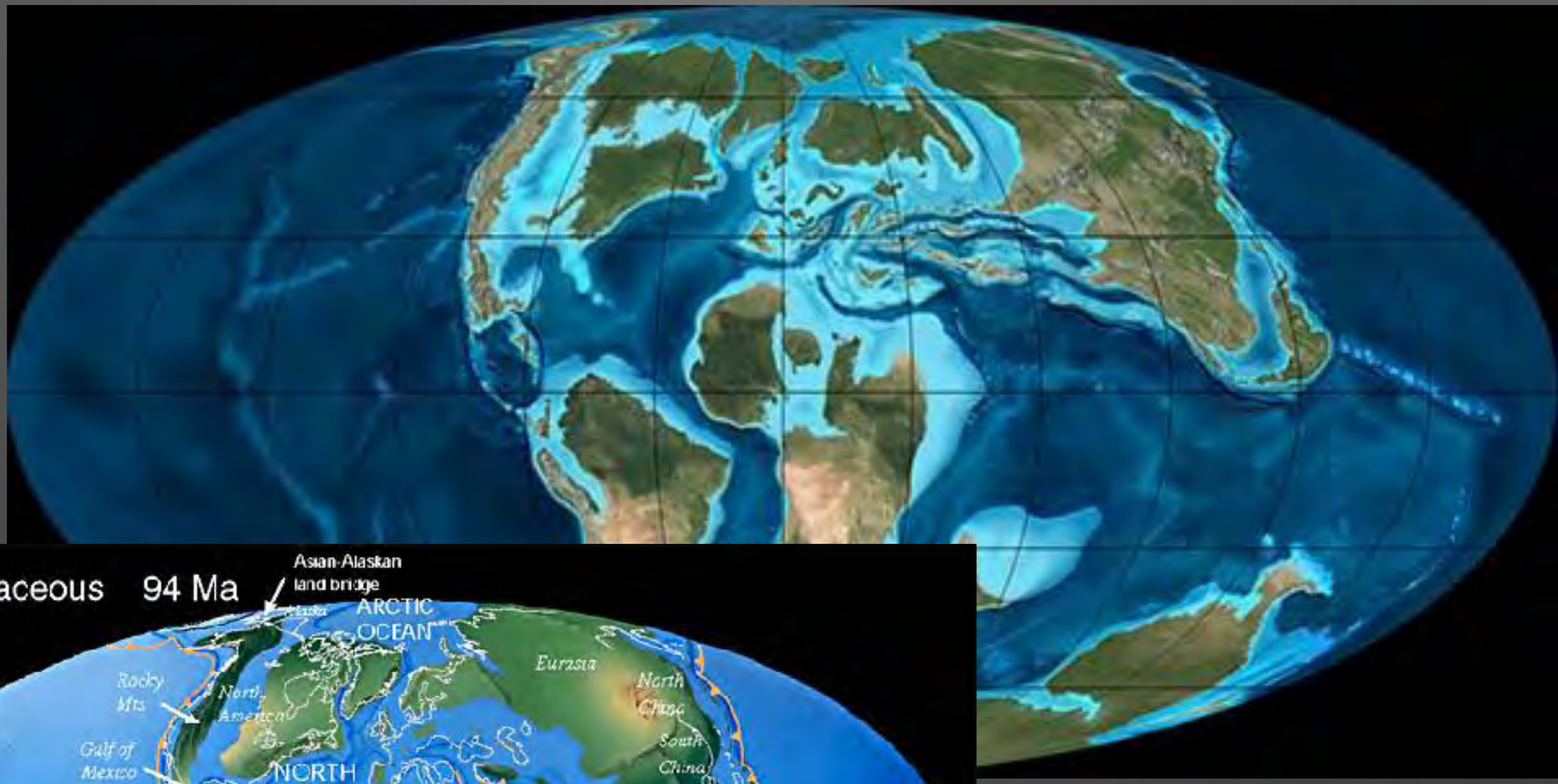
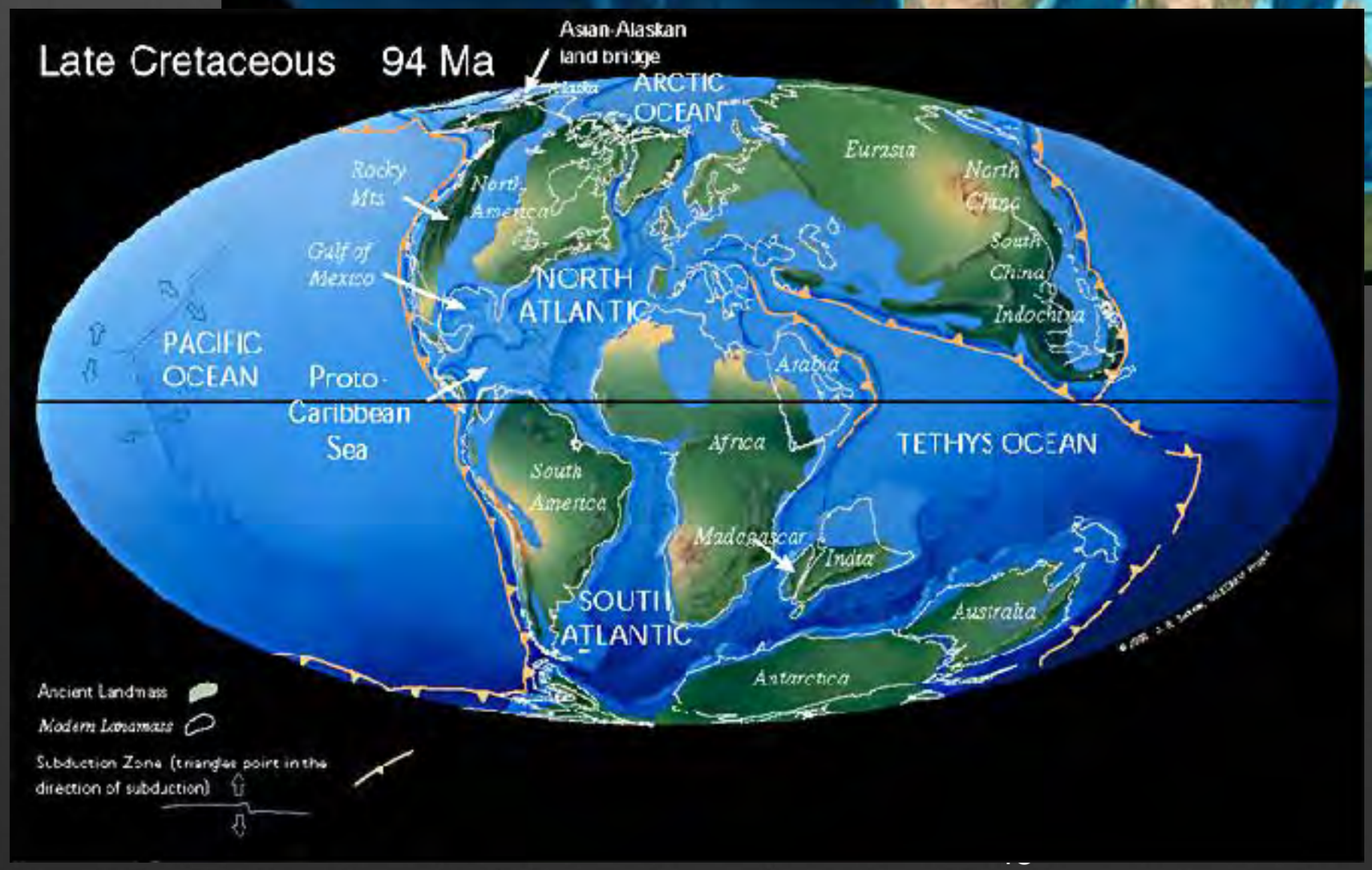


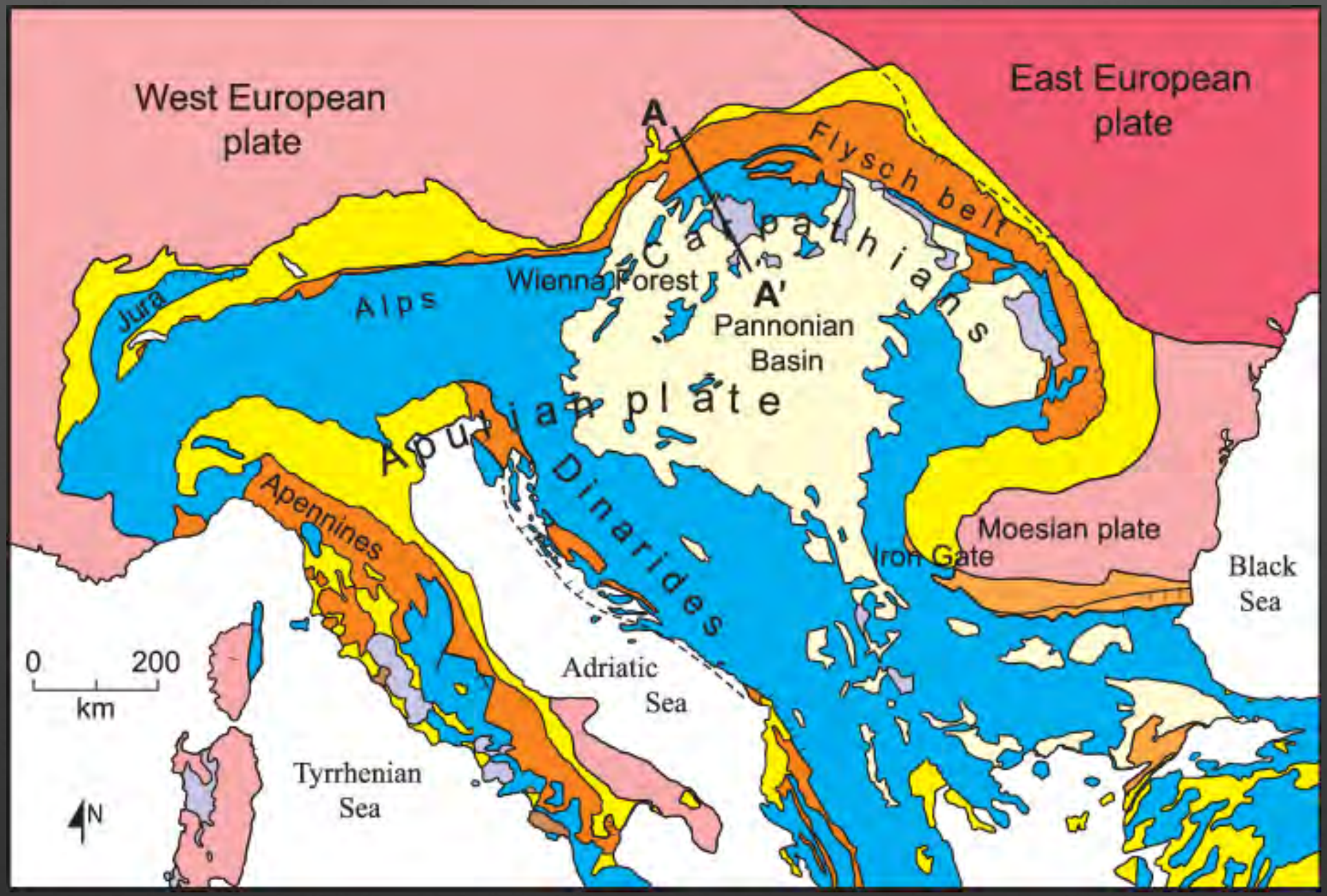
Late Jurassic 152 Ma

Siberia
Amurian Seaway
Ural Mts.
North China
Alaska
LAURASIA
Europe
North America
South China
Sierra Nevada
Turkey
Iran
Tibet
Indochina
Southeast Asia
PACIFIC OCEAN
Tethyan Trench
TETHYS OCEAN
Gulf of Mexico
Central Atlantic Ocean
South America
Africa
Arabia
GONDWANA
India
Australia
Antarctica

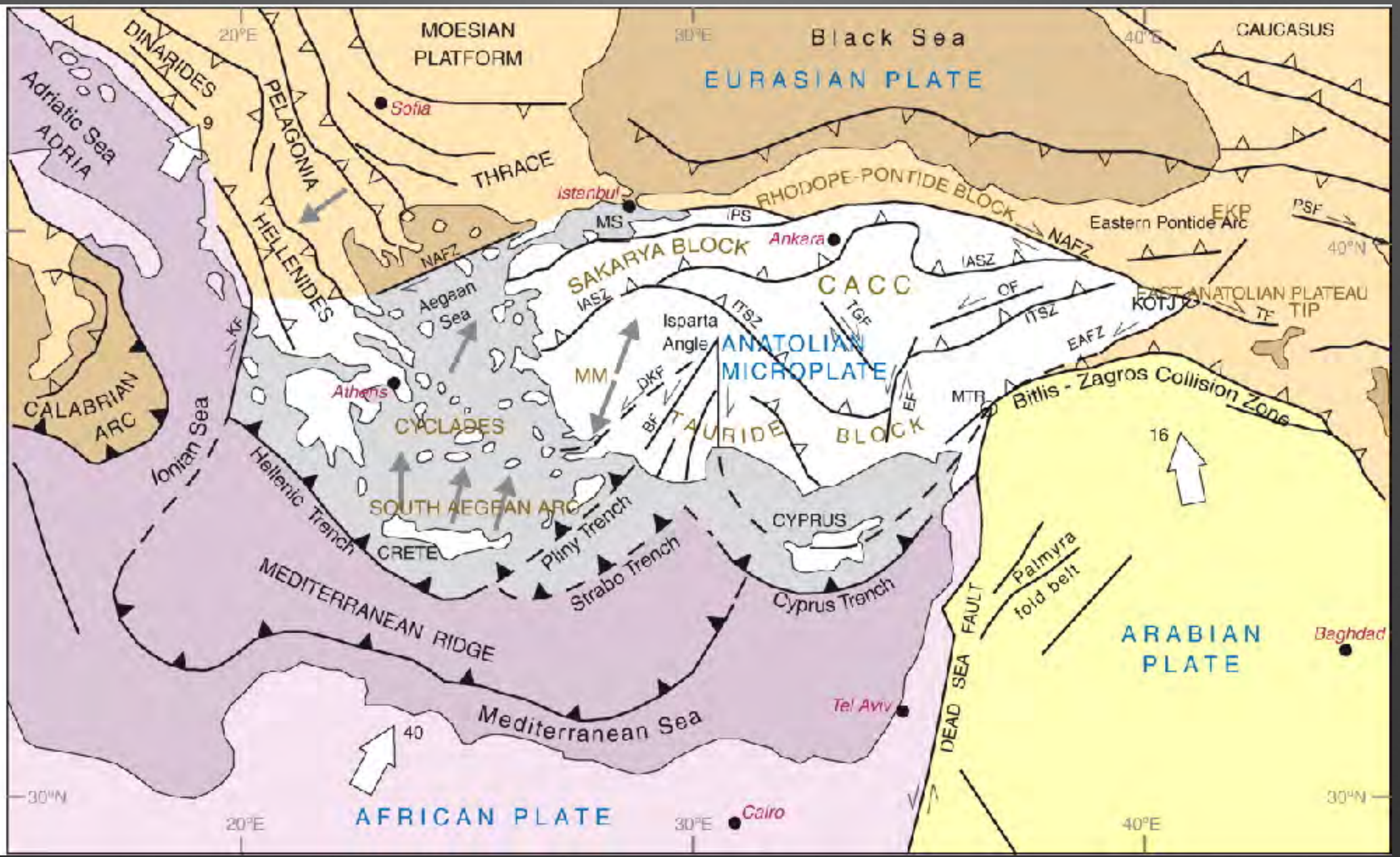
Ancient landmass
Modern landmass
Subduction zone (triangles point in the direction of subduction)
Sea floor spreading ridge

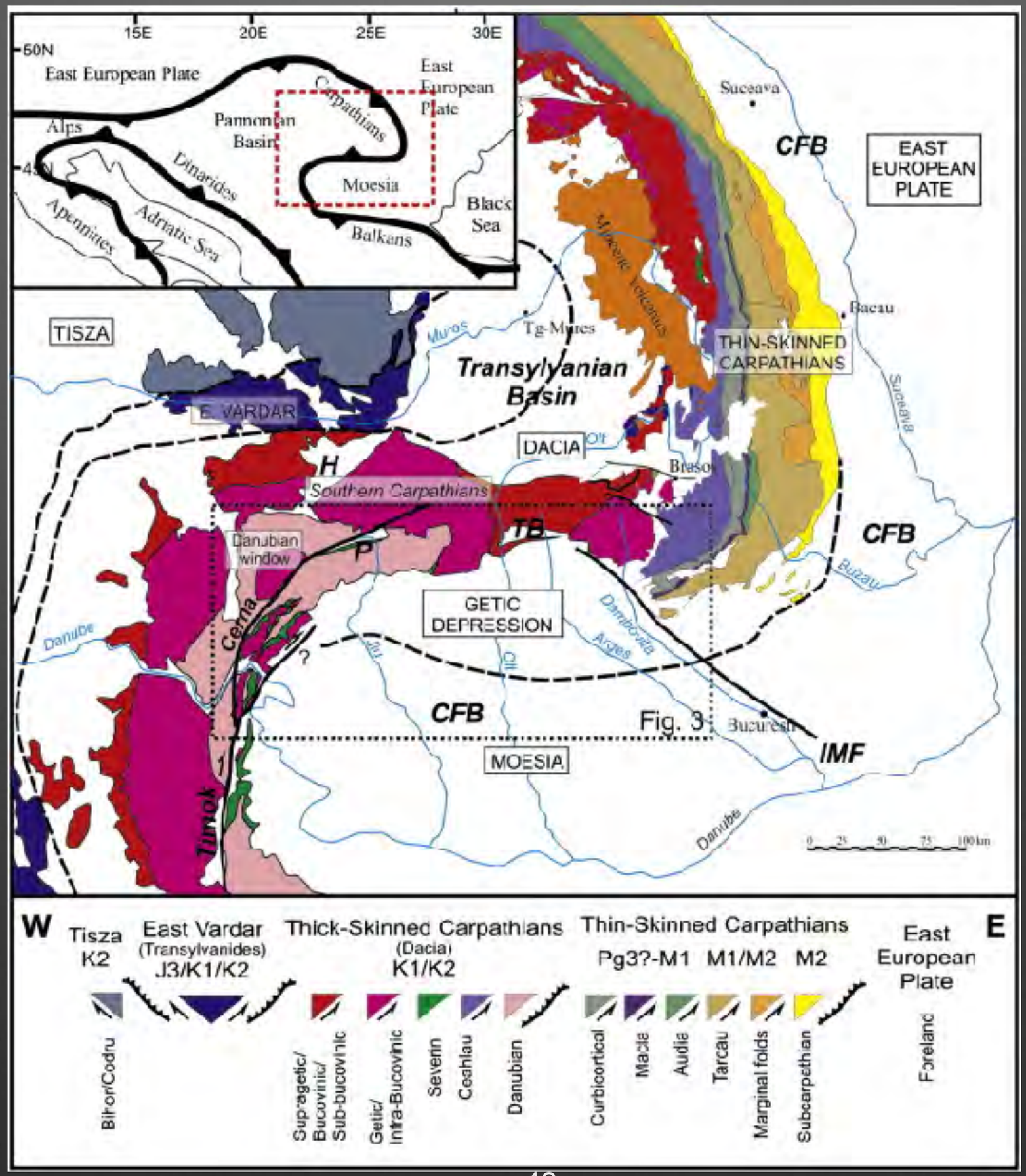


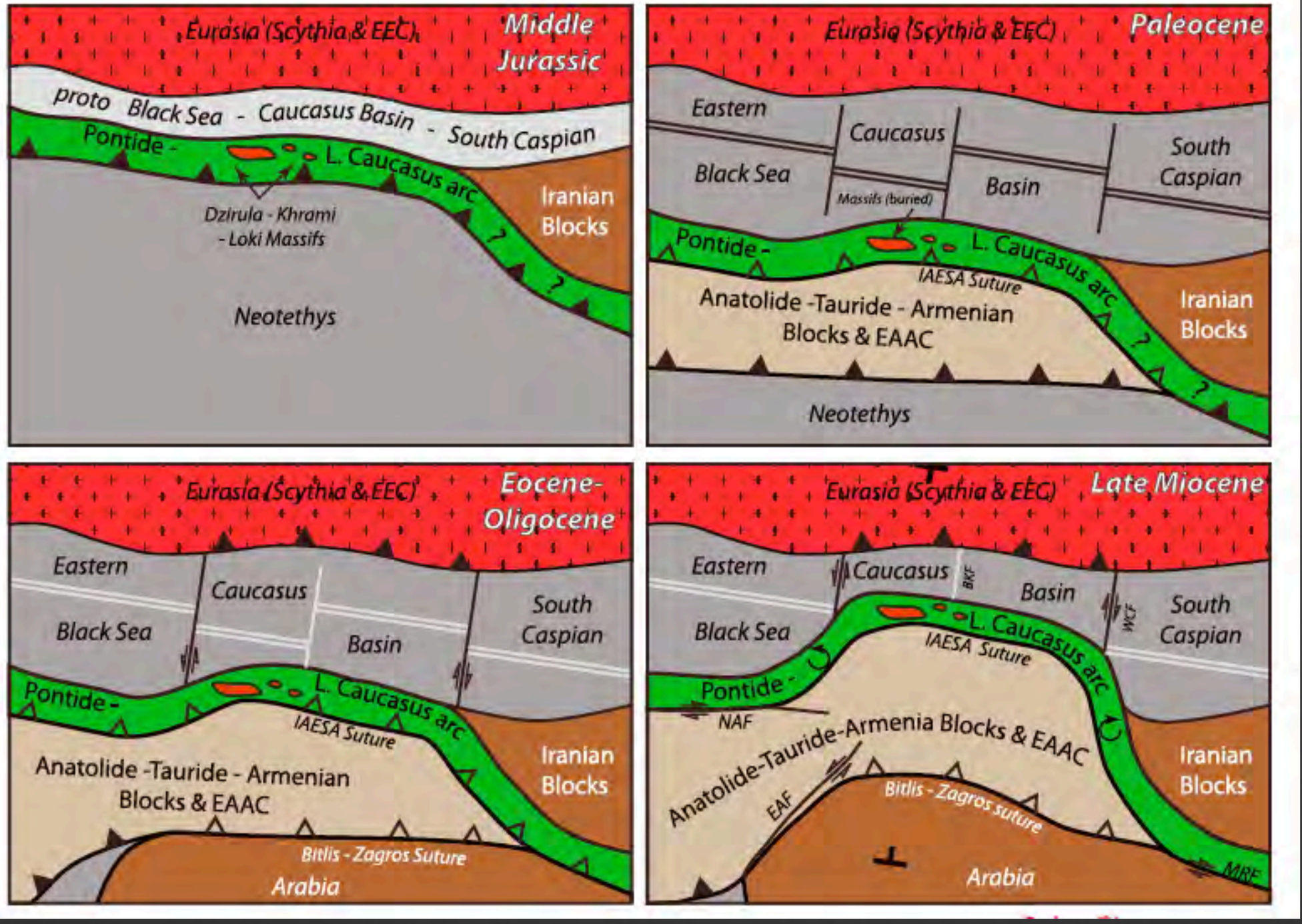

Late Cretaceous 94 Ma
Asian-Alaskan land bridge
ARCTIC OCEAN
Eurasia
North China
South China
Indochina
Rocky Mts
North America
Gulf of Mexico
NORTH ATLANTIC
PACIFIC OCEAN
Proto-Caribbean Sea
Arabia
Africa
TETHYS OCEAN
South America
Madagascar
India
SOUTH ATLANTIC
Australia
Antarctica
Ancient Landmass
Modern Landmass
Subduction Zone (triangles point in the direction of subduction)

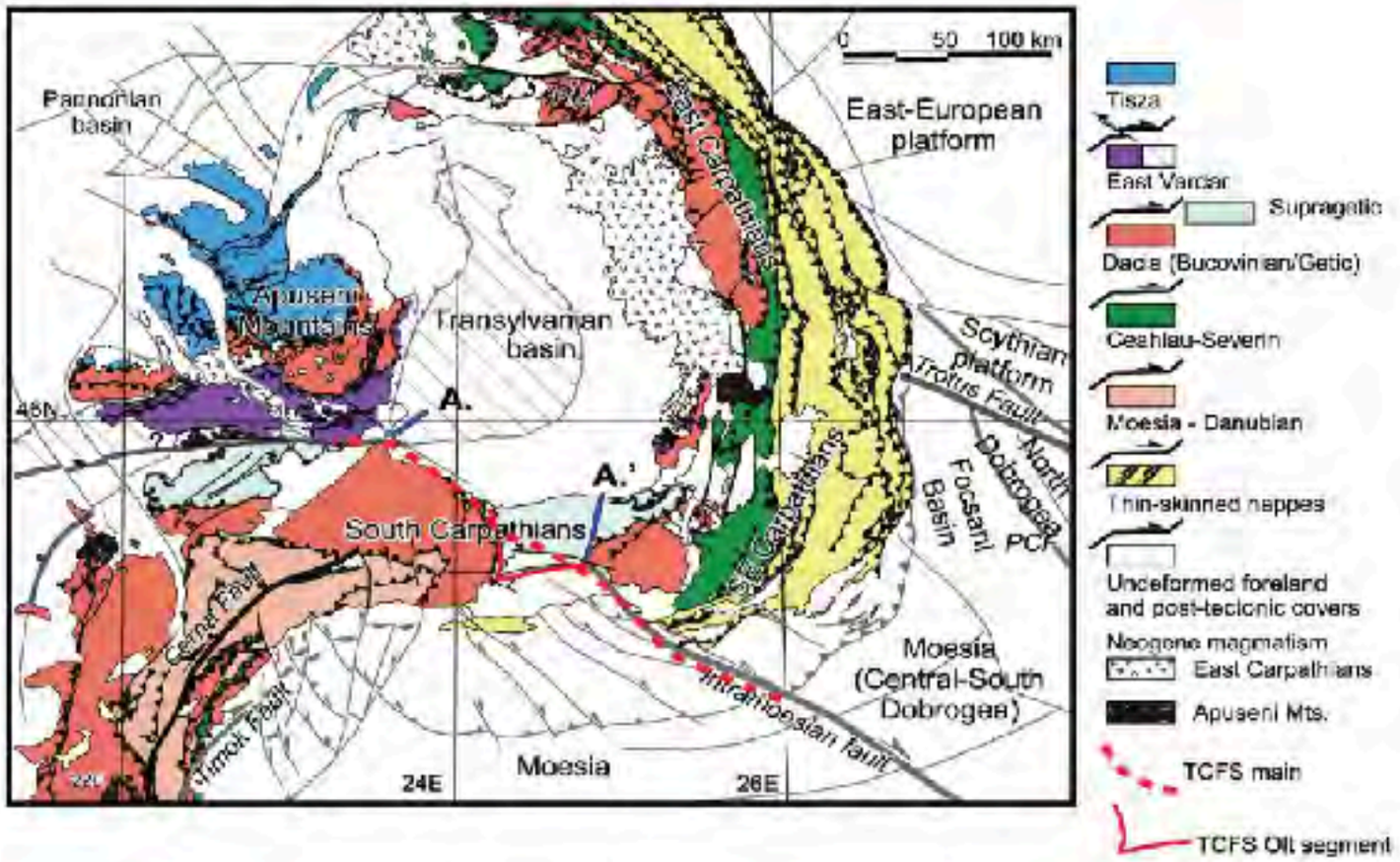

West European plate
East European plate
A
A'
Flysch belt
Carpathians
Wienna Forest
Jura
Alps
Pannonian Basin
plate
Apulian plate
Dinarides
Apennines
Moesian plate
Iron Gate
Black Sea
0
200
km
Adriatic Sea
Tyrrhenian Sea
N

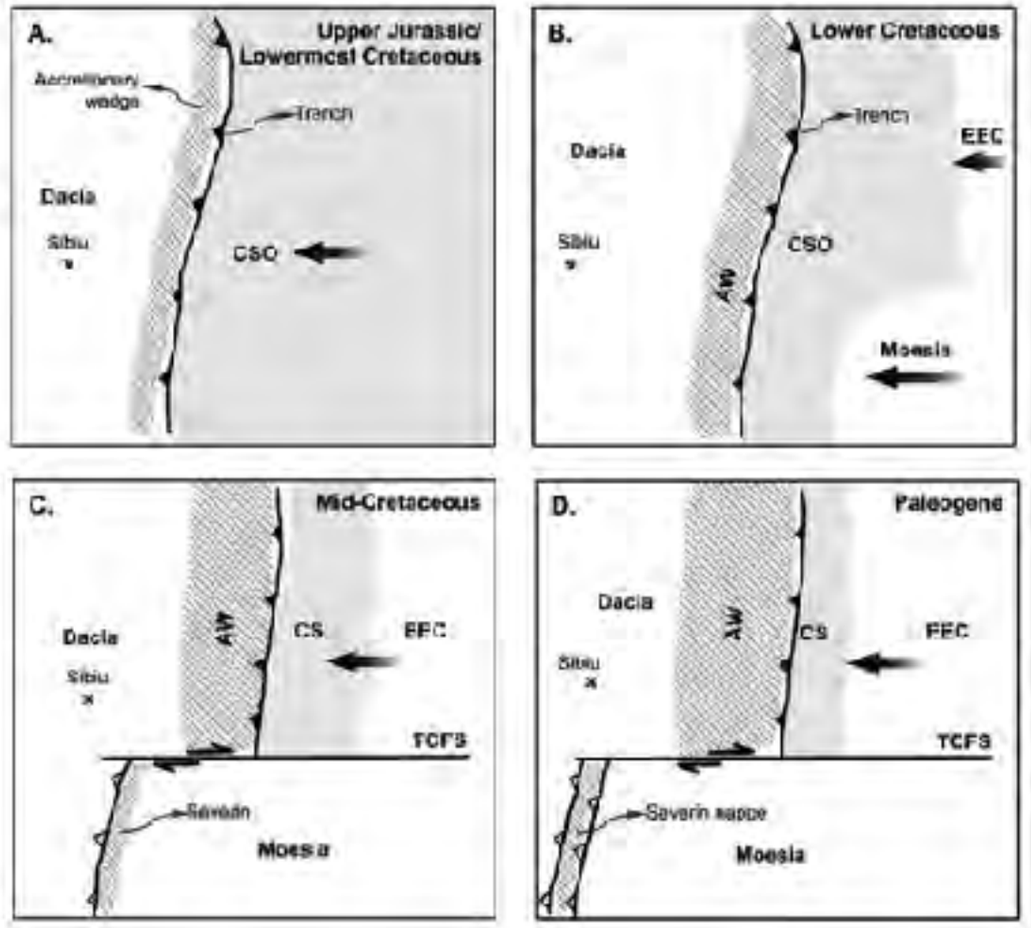
b)


20°E
30°E
40°E
MOESIAN PLATFORM
Black Sea
EURASIAN PLATE
CAUCASUS
DINARIDES
Adriatic Sea
ADRIA
PELAGONIA
HELLENIDES
Sofia
THRACE
Istanbul
MS
IPS
RHODOPE-PONTIDE BLOCK
NAFZ
Eastern Pontide Arc
EKP
PSF
40°N
Ankara
SAKARYA BLOCK
IASZ
CACC
OF
ITSZ
EAST ANATOLIAN PLATEAU
KOTJ
TF
TIP
Aegean Sea
Isparta Angle
ANATOLIAN MICROPLATE
TGF
EAFZ
MM
DKF
BF
EF
MTR
Bitlis - Zagros Collision Zone
Athens
CYCLADES
TAURIDE
BLOCK
CALABRIAN ARC
KF
Ionian Sea
Hellenic Trench
16
SOUTH AEGEAN ARC
CRETE
Pliny Trench
Strabo Trench
CYPRUS
Cyprus Trench
Palmyra fold belt
DEAD SEA FAULT
ARABIAN PLATE
Baghdad
MEDITERRANEAN RIDGE
Tel Aviv
Mediterranean Sea
40
30°N
AFRICAN PLATE
Cairo
20°E
30°E
40°E
30°N


15E
20E
25E
30E
50N
East European Plate
East European Plate
Carpathians
Pannonian Basin
Alps
Dinarides
Moesia
Black Sea
Adriatic Sea
Apennines
Balkans
TISZA
Mures
Tg-Mures
Transylvanian Basin
E. VARDAR
H
Southern Carpathians
TB
P
Danubian window
Cerna
Danube
GETIC DEPRESSION
Jiu
Olt
Arges
Dambovita
?
CFB
Fig. 3
Bucuresti
IMF
MOESIA
Timok
Suceava
CFB
EAST EUROPEAN PLATE
Quaternary volcanics
THIN-SKINNED CARPATHIANS
Bacau
Siret
DACIA
Brasov
CFB
Buzau
0 25 50 75 100 km
W
Tisza
K2
East Vardar
(Transylvanides)
J3/K1/K2
Thick-Skinned Carpathians
(Dacia)
K1/K2
Thin-Skinned Carpathians
Pg3?-M1
M1/M2
M2
East European Plate
E
Bihor/Codru
Supragetic/ Bucovinic/ Sub-bucovinic
Getic/ Intra-Bucovinic
Severin
Ceahlau
Danubian
Curbicortical
Macla
Audia
Tarcau
Marginal folds
Subcarpathian
Foreland

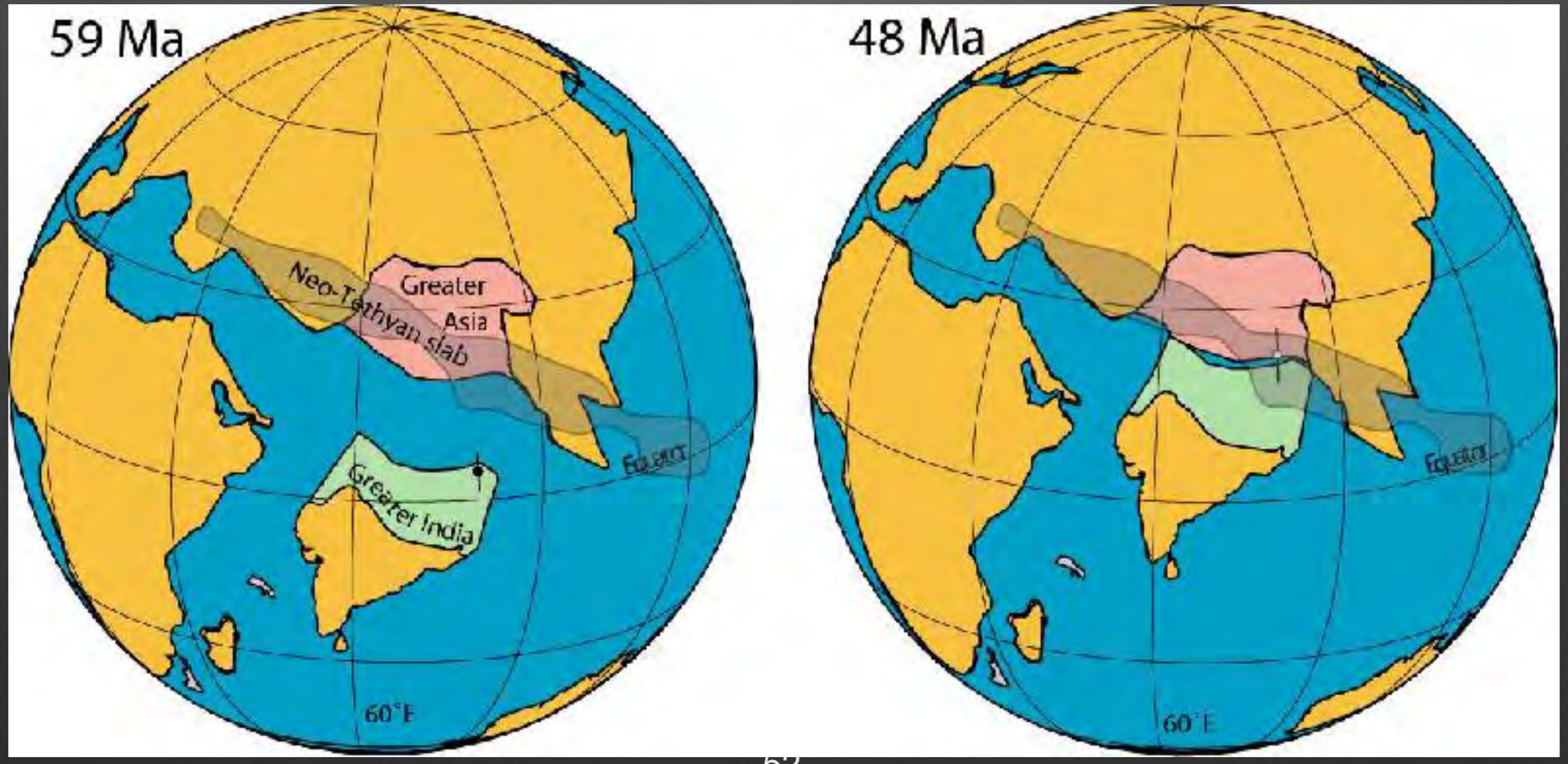

Eurasia (Scythia & EEC)
Middle Jurassic
proto Black Sea - Caucasus Basin - South Caspian
Pontide -
L. Caucasus arc
Dzirula - Khrami - Loki Massifs
Iranian Blocks
Neotethys
Eurasia (Scythia & EEC)
Paleocene
Eastern Black Sea
Caucasus Basin
South Caspian
Massifs (buried)
Pontide -
L. Caucasus arc
IAESA Suture
Anatolide -Tauride - Armenian Blocks & EAAC
Iranian Blocks
Neotethys
Eurasia (Scythia & EEC)
Eocene-Oligocene
Eastern Black Sea
Caucasus Basin
South Caspian
Pontide -
L. Caucasus arc
IAESA Suture
Anatolide -Tauride - Armenian Blocks & EAAC
Iranian Blocks
Bitlis - Zagros Suture
Arabia
Eurasia (Scythia & EEC)
Late Miocene
Eastern Black Sea
Caucasus
BKF
Basin
WKF
South Caspian
L. Caucasus arc
IAESA Suture
Pontide -
NAF
Anatolide-Tauride-Armenia Blocks & EAAC
EAF
Bitlis - Zagros suture
Iranian Blocks
Arabia
MRF

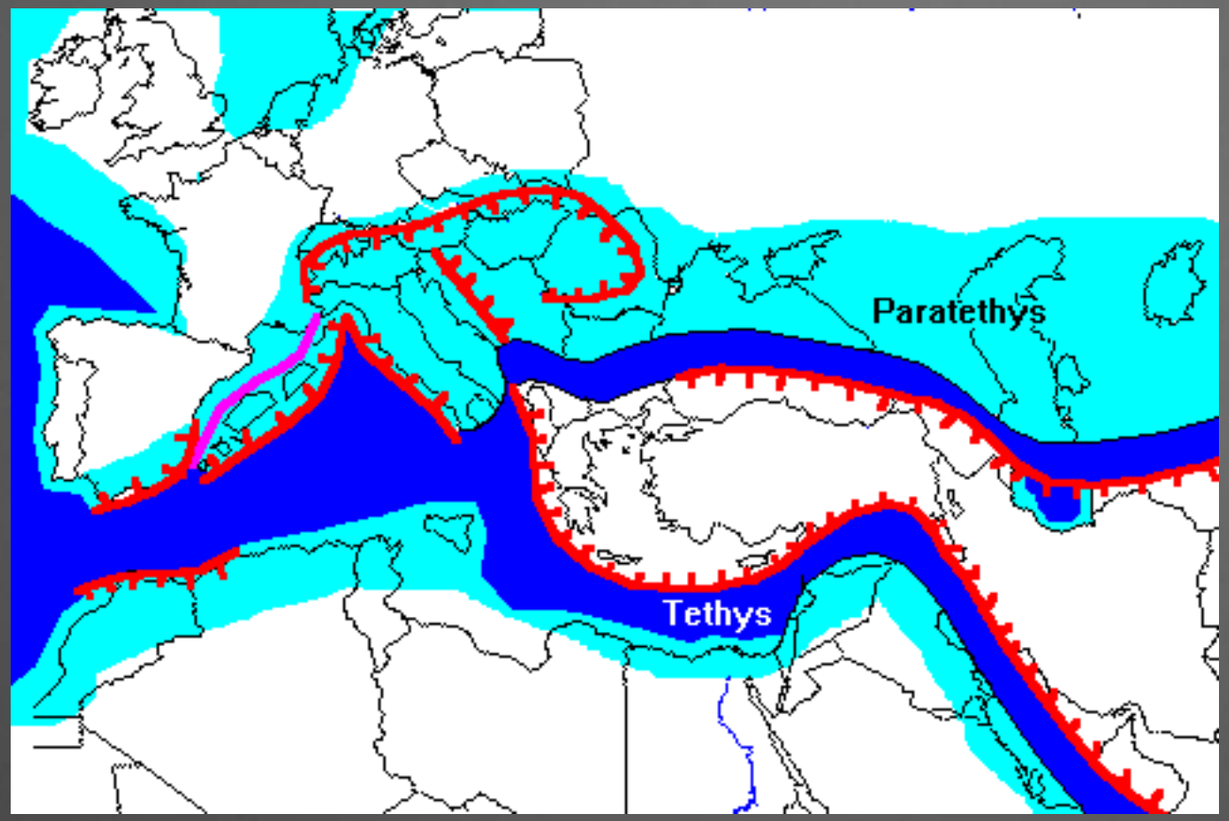

0 50 100 km
Pannonian basin
East-European platform
Apuseni Mountains
Transylvanian basin
A.
A'
South Carpathians
East Carpathians
Scythian platform
Trotus Fault
North Dobrogea PCB
Focsani Basin
Cerna Fault
Intramoesian fault
Moesia (Central-South Dobrogea)
Moesia
46N
24E
26E
Tisza
East Vardar
Supragetic
Dacia (Bucovinian/Getic)
Ceahlau-Severin
Moesia - Danubian
Thin-skinned nappes
Undeformed foreland and post-tectonic covers
Neogene magmatism
East Carpathians
Apuseni Mts.
TCFS main
TCFS Olt segment

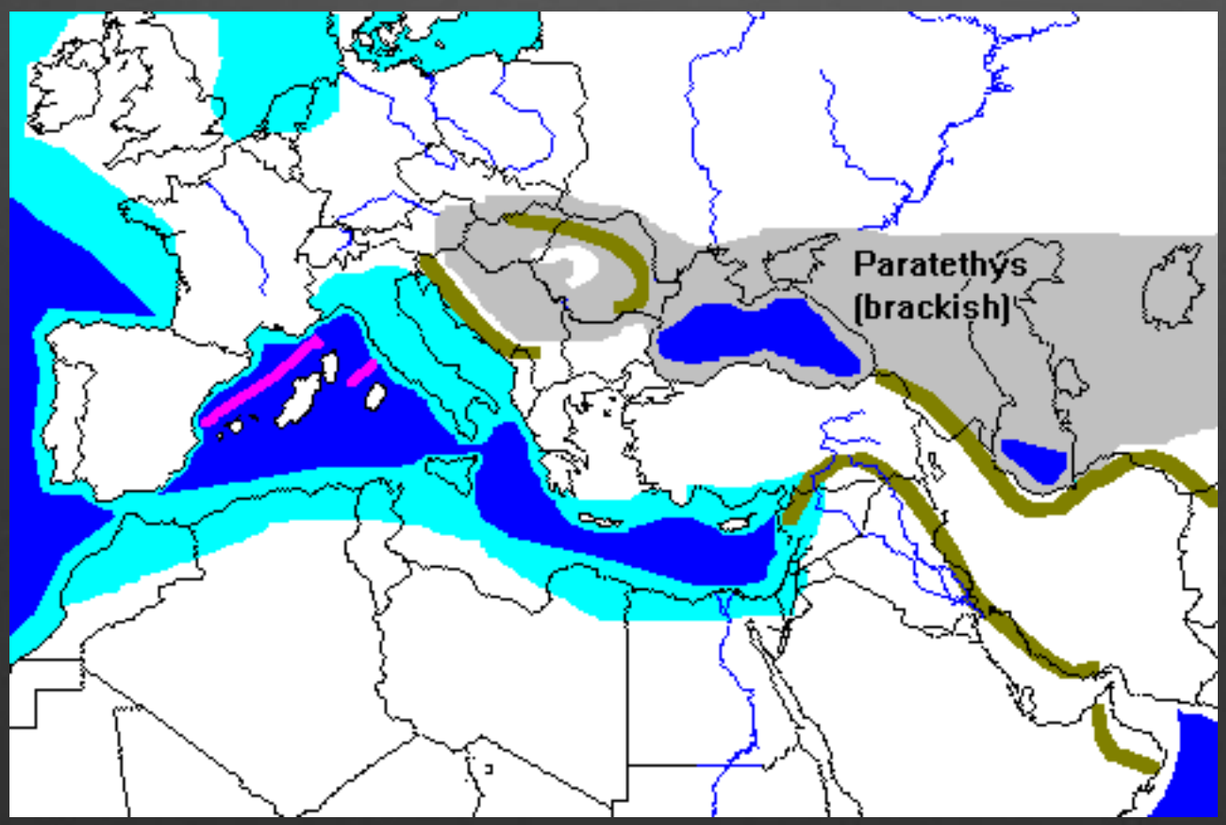

A.
Upper Jurassic/ Lowermost Cretaceous
Accretionary wedge
Trench
Dacia
Sibiu
CSO
B.
Lower Cretaceous
Trench
EEC
Dacia
Sibiu
CSO
AW
Moesia
C.
Mid-Cretaceous
Dacia
Sibiu
AW
CS
EEC
TCFS
Severin
Moesia
D.
Paleogene
Dacia
Sibiu
AW
CS
EEC
TCFS
Severin nappe
Moesia


Balaur bondoc

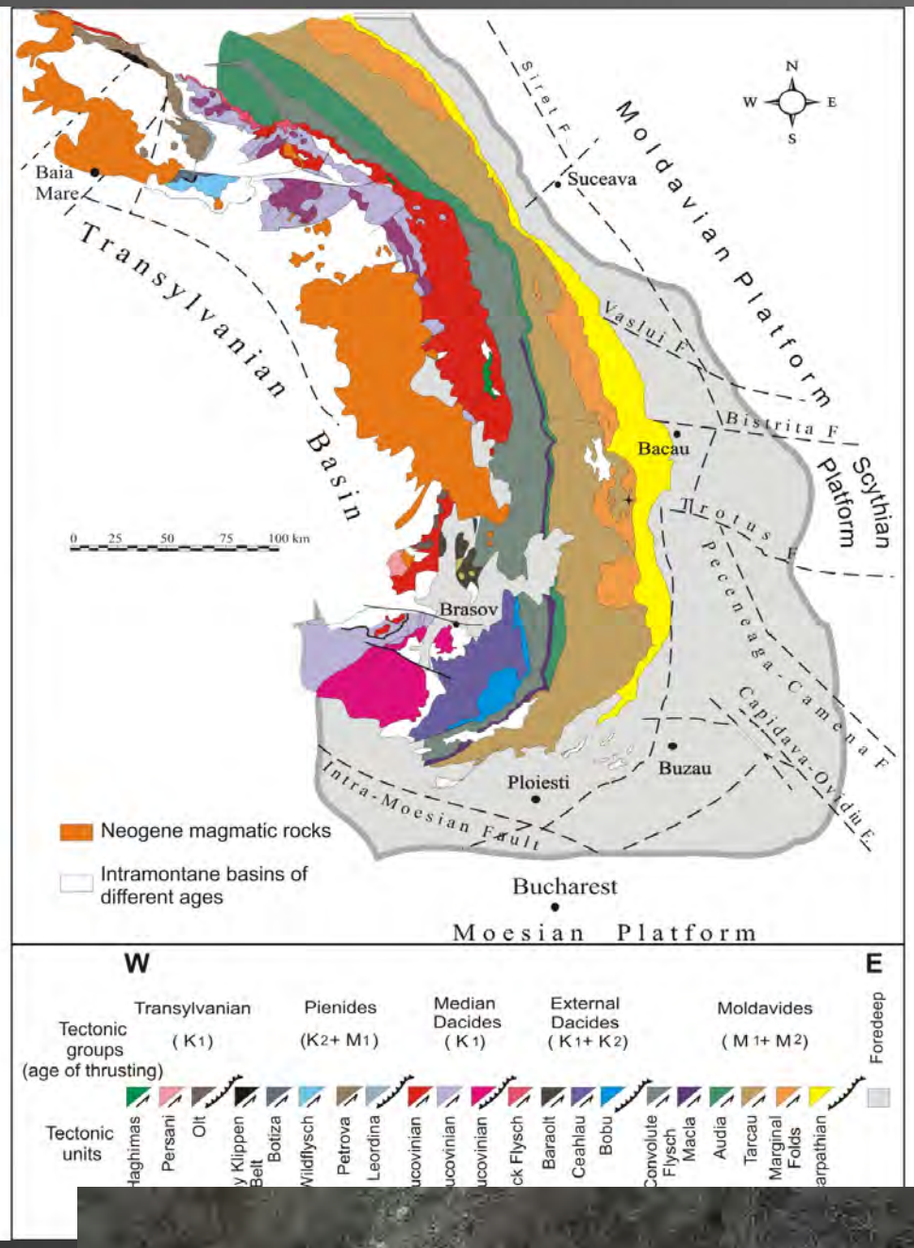
Figure 1:
Reconstructed Eurasian palaeogeography in the late Eocene, 35 million years ago. (http://cpgeosystems.com/) This particular reconstruction shows an elongated, shallow Paratethys with open marine gateways to the eastern Tethys Ocean and North Sea.

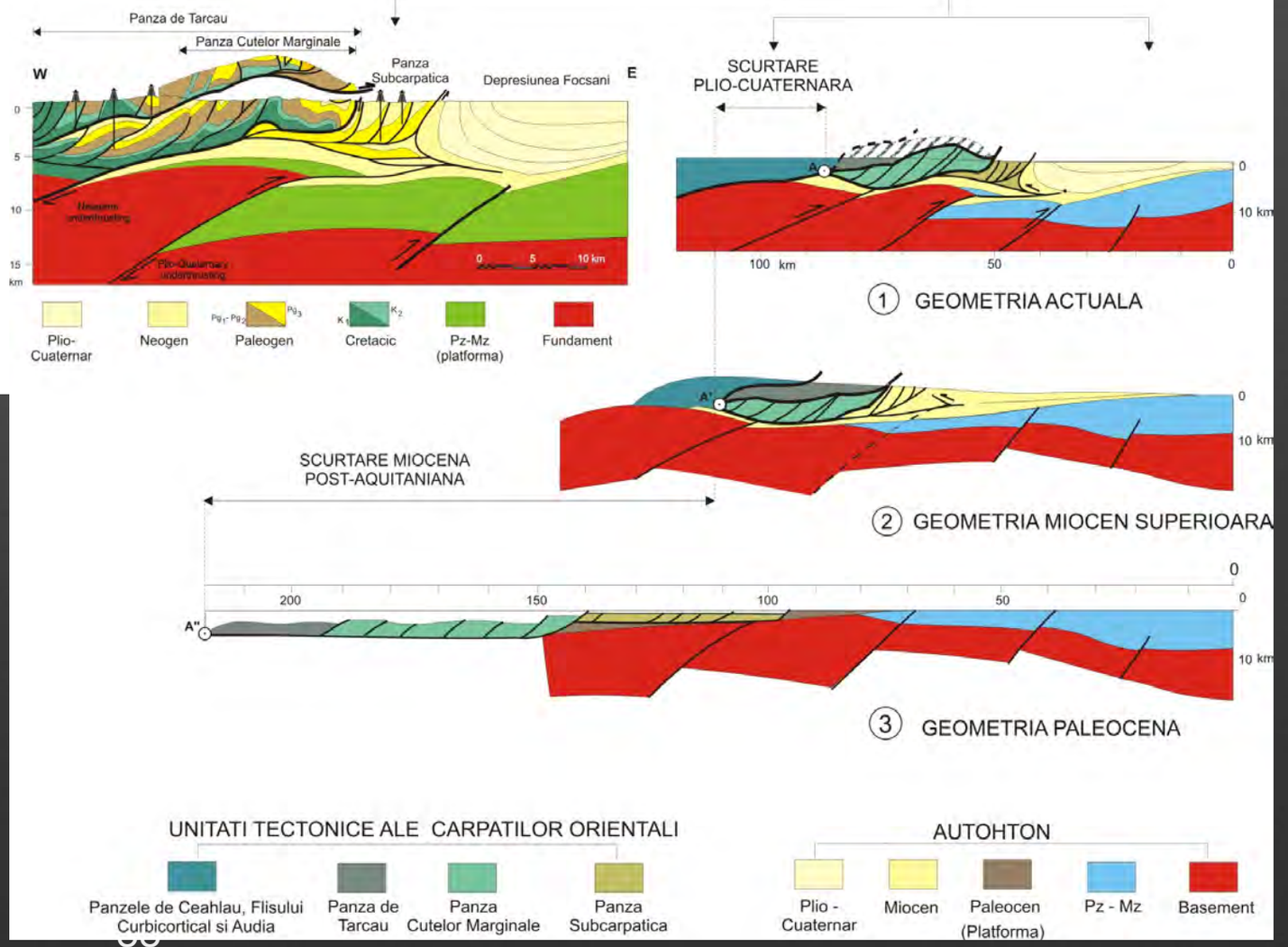


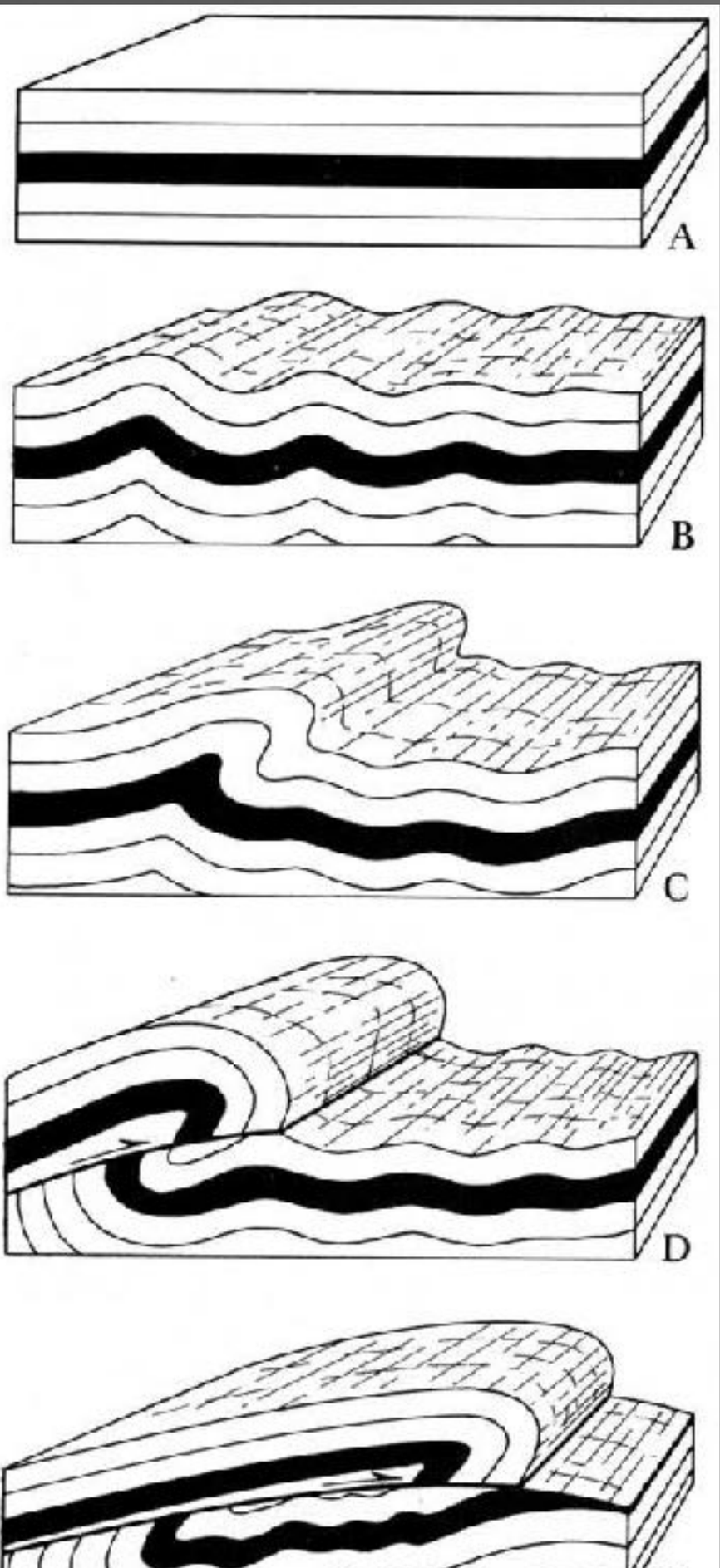

Paratethys
Tethys


Paratethys
(brackish)

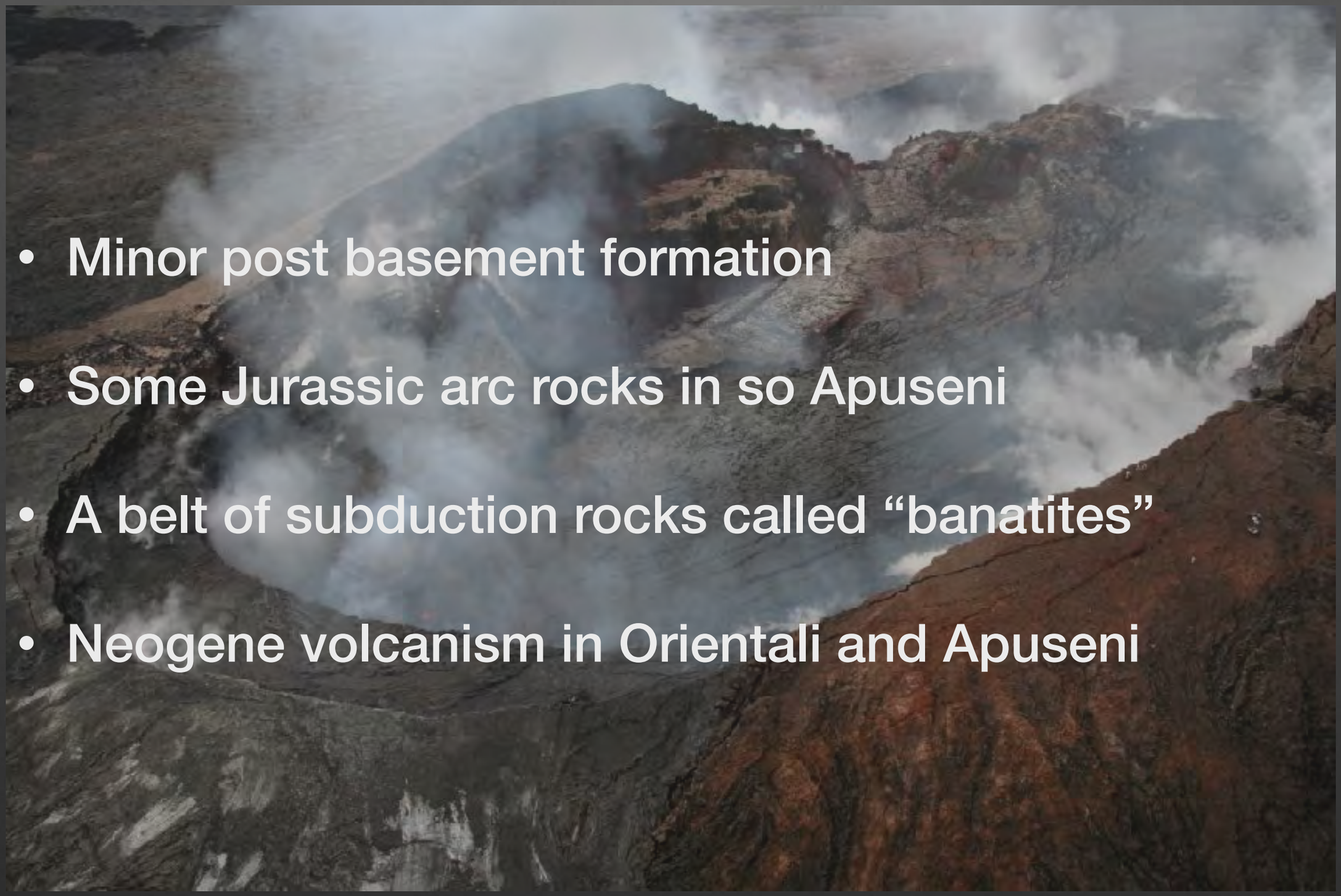
From: *http://cpgeosystems.com/13_Mid_Mio_Eurmap_sm.jpg*, July 2015


Sirel F.
Moldavian Platform
N
W
E
S
Suceava
Baia Mare
Transylvanian Basin
Vaslui F.
Bistrita F.
Bacau
Scythian Platform
Trotus F.
Pecineaga - Camena F.
Capidava-Ovidiu F.
0 25 50 75 100 km
Brasov
Buzau
Ploiesti
Intra-Moesian Fault
Neogene magmatic rocks
Intramontane basins of different ages
Bucharest
Moesian Platform
W
E
Tectonic groups (age of thrusting)
Transylvanian (K1)
Pienides (K2+ M1)
Median Dacides (K1)
External Dacides (K1+ K2)
Moldavides (M1+ M2)
Foredeep
Tectonic units
Haghimas
Persani
Olt
Klippen Belt
Botiza
Wildflysch
Petrova
Leordina
Bucovinian
Bucovinian
Bucovinian
ck Flysch
Baraolt
Ceahlau
Bobu
Convolute Flysch
Macla
Audia
Tarcau
Marginal Folds
arpathian


Panza de Tarcau
Panza Cutelor Marginale
W
E
Panza Subcarpatica
Depresiunea Focsani
Neogen underthrusting
Plio-Quaternary underthrusting
0 5 10 km
Plio-Cuaternar
Neogen
Paleogen
Cretacic
Pz-Mz (platforma)
Fundament
SCURTARE PLIO-CUATERNARA
100 km
50
1 GEOMETRIA ACTUALA
SCURTARE MIOCENA POST-AQUITANIANA
200
150
100
50
2 GEOMETRIA MIOCEN SUPERIOARA
3 GEOMETRIA PALEOCENA
UNITATI TECTONICE ALE CARPATILOR ORIENTALI
Panzele de Ceahlau, Flisului Curbicortical si Audia
Panza de Tarcau
Panza Cutelor Marginale
Panza Subcarpatica
AUTOHTON
Plio - Cuaternar
Miocen
Paleocen (Platforma)
Pz - Mz
Basement


A
B
C
D
E

Volcanism



- Minor post basement formation
- Some Jurassic arc rocks in so Apuseni
- A belt of subduction rocks called “banatites”
- Neogene volcanism in Orientali and Apuseni

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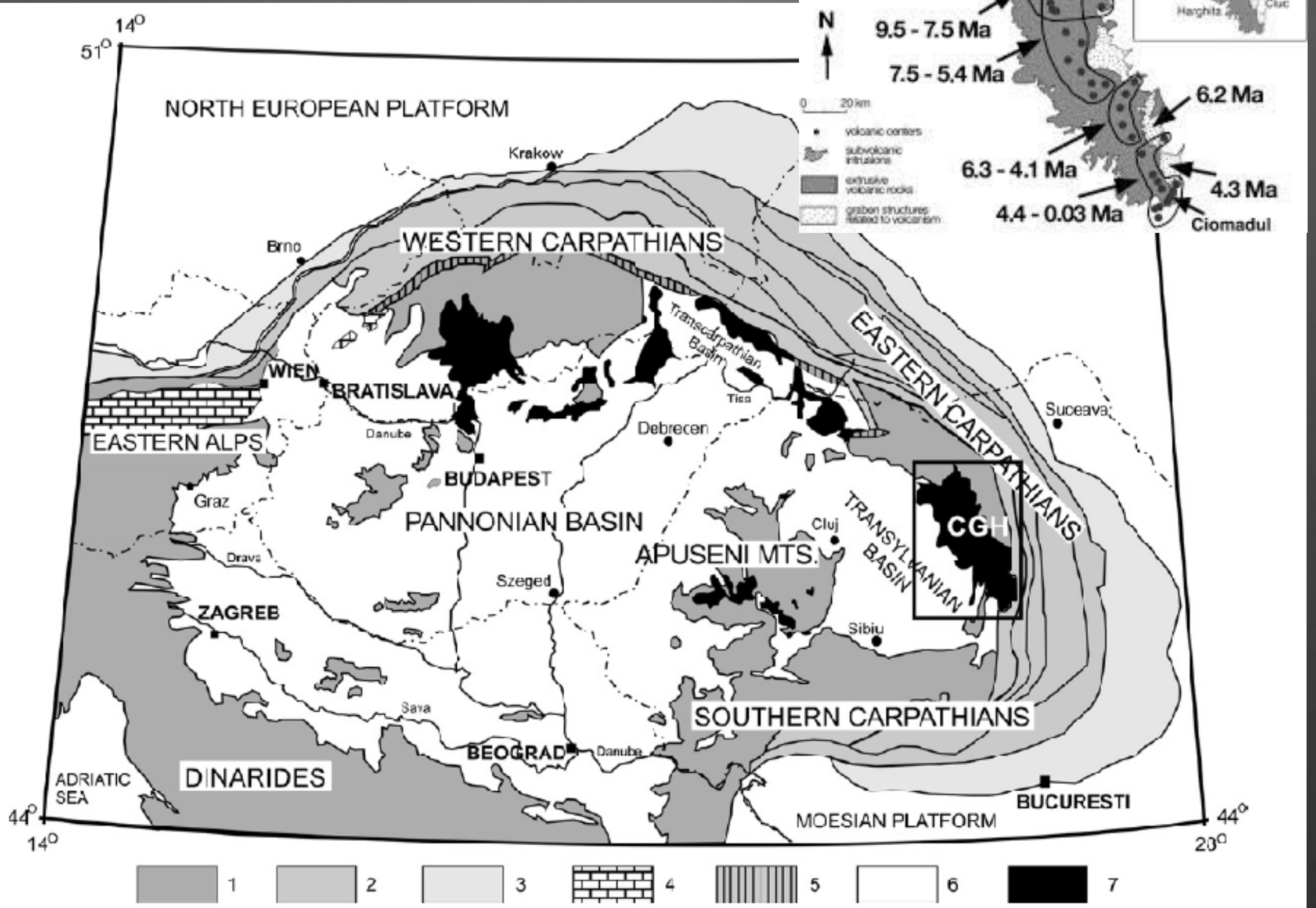
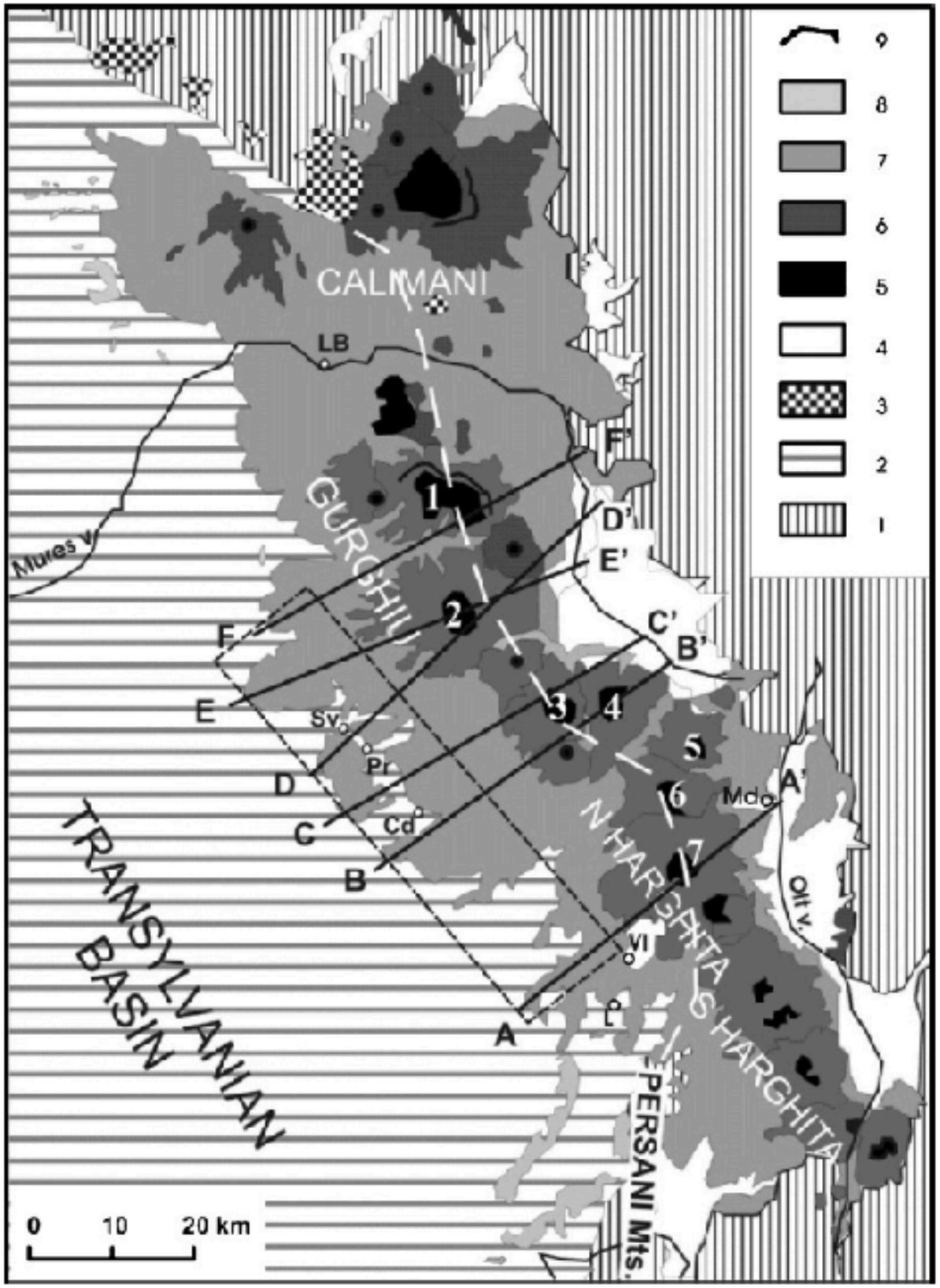
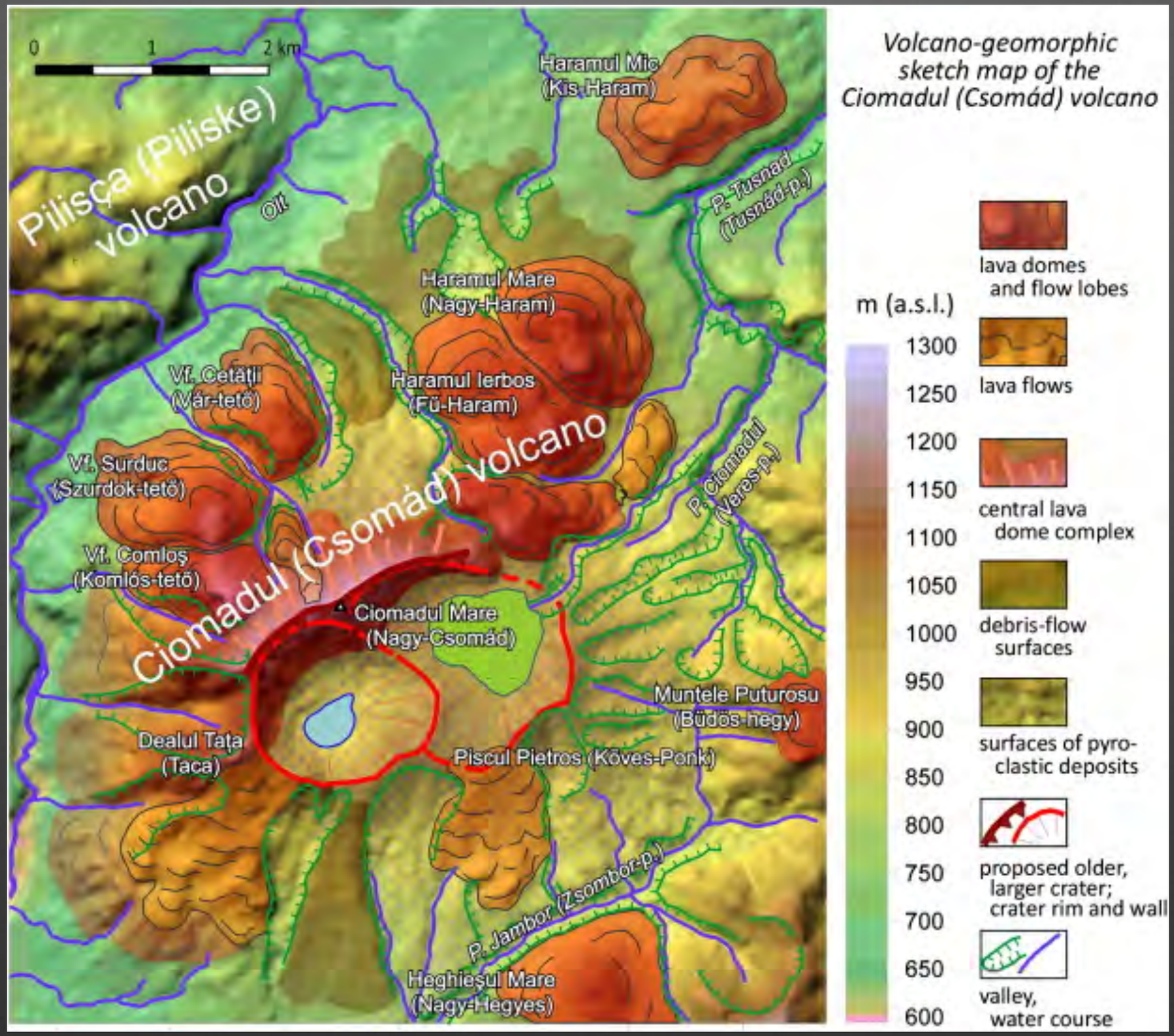
CARTE GÉOLOGIQUE

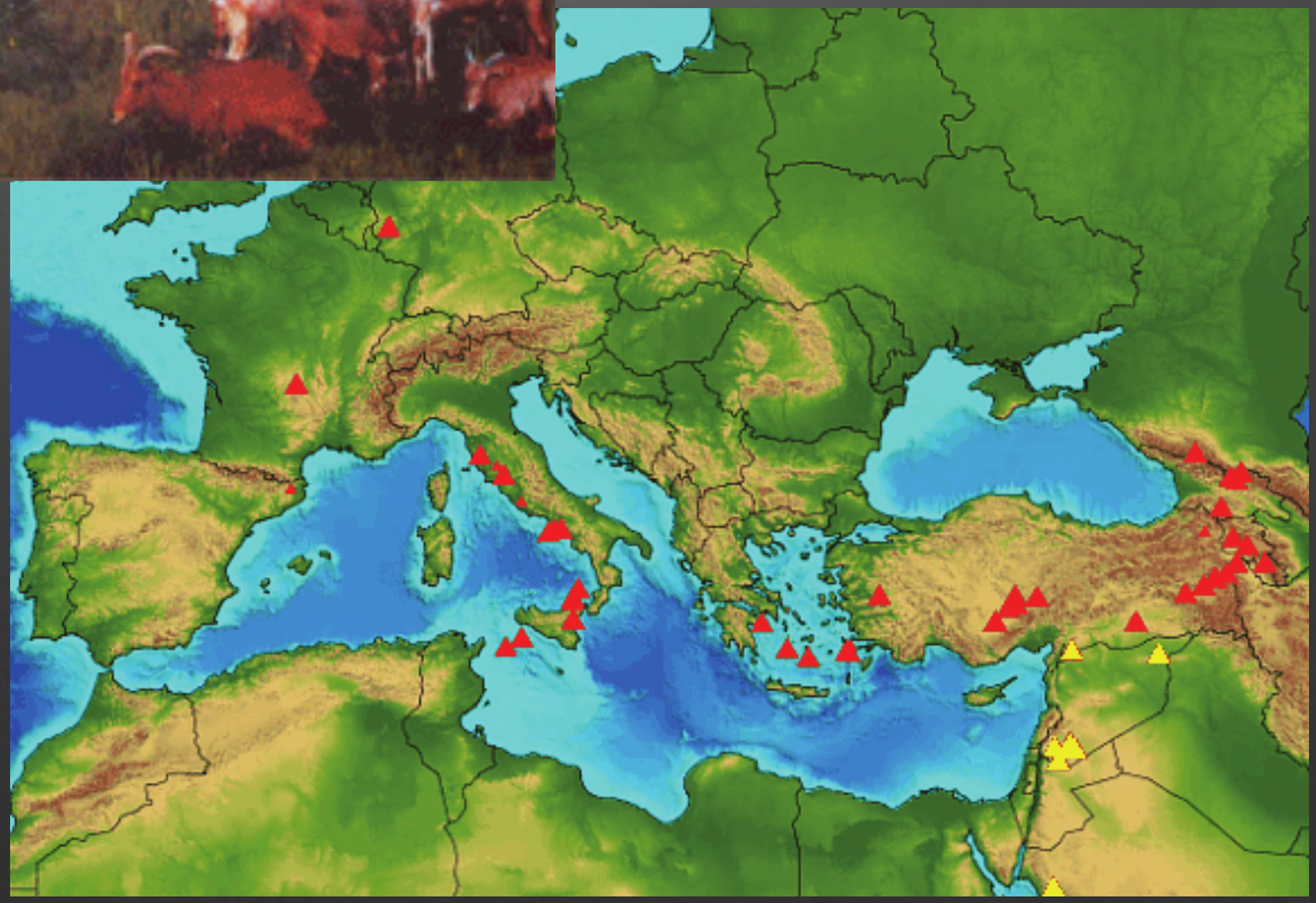

K-Ar ages
10.5 - 9.5 Ma
9.5 - 7.5 Ma
7.5 - 5.4 Ma
6.2 Ma
6.3 - 4.1 Ma
4.3 Ma
4.4 - 0.03 Ma
Ciomadul
N
0 20 km
volcanic centers
subvolcanic intrusions
extrusive volcanic rocks
graben structures related to volcanism
Calimani
Bibor-Borsec
Gurghiu
Harghita
Ciuc
14°
51°
NORTH EUROPEAN PLATFORM
Krakow
Brno
WESTERN CARPATHIANS
Transcarpathian Basin
EASTERN CARPATHIANS
WIEN
BRATISLAVA
Tisa
Suceava
Danube
Debrecen
EASTERN ALPS
BUDAPEST
Graz
PANNONIAN BASIN
Cluj
TRANSYLVANIAN BASIN
CGH
APUSENI MTS.
Drava
Szeged
ZAGREB
Sibiu
Sava
SOUTHERN CARPATHIANS
BEOGRAD
Danube
ADRIATIC SEA
DINARIDES
BUCURESTI
MOESIAN PLATFORM
44°
14°
20°
1
2
3
4
5
6
7


9
8
7
6
5
4
3
2
1
CALIMANI
LB
GURGHIU
Mures v.
F'
D'
E'
C'
B'
A'
1
2
3
4
5
6
7
F
E
D
C
B
A
Sv.
Pr.
Cd.
Mdo.
Olt v.
Vl.
Lt.
N HARGHITA
S HARGHITA
PERSANI Mts.
TRANSYLVANIAN BASIN
0
10
20 km

Origin of magmatism

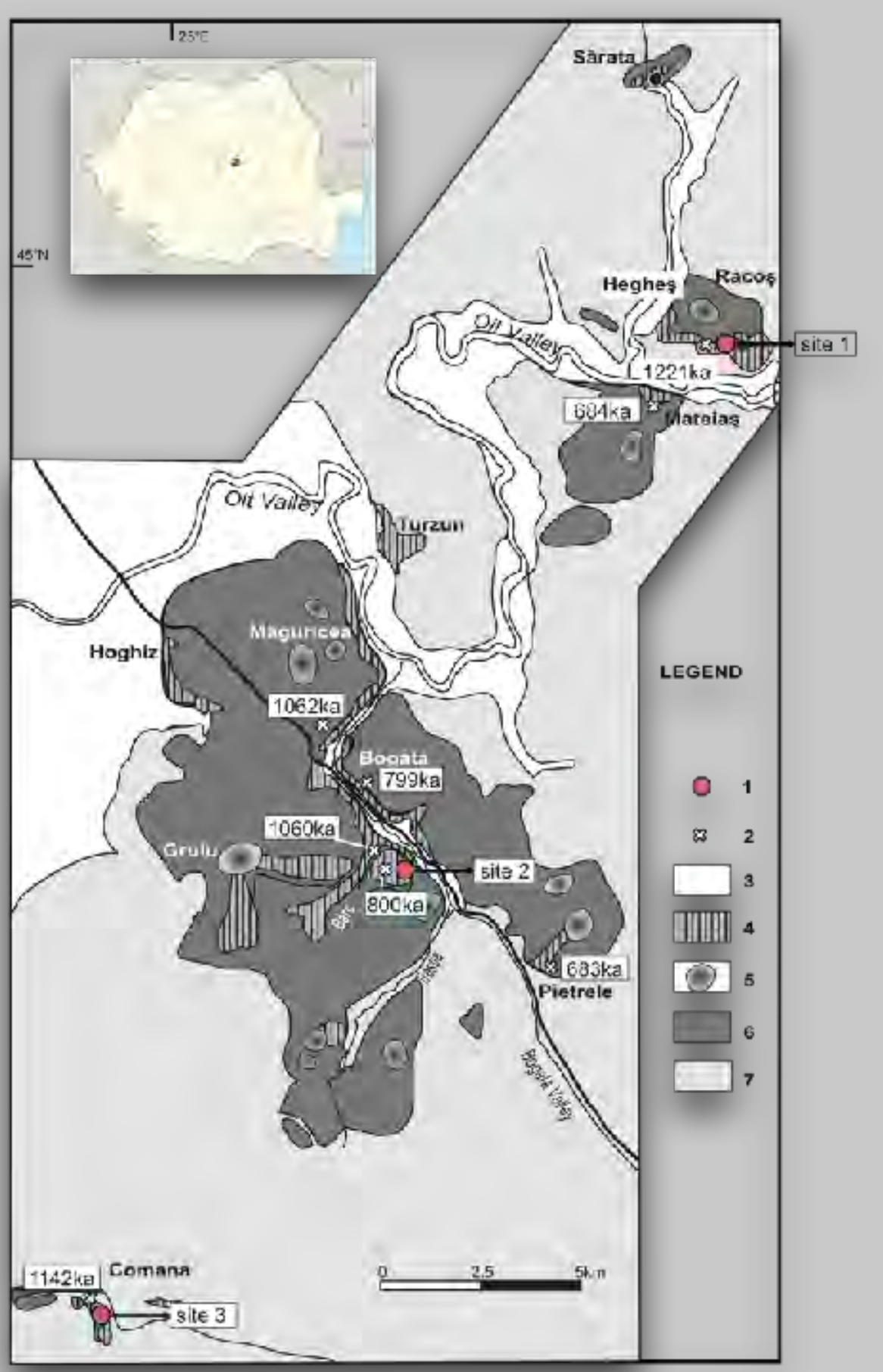
- Compositions are subduction-related like but there is no obvious subduction -
- Ages progressing southward calls for some unusual geologic scanario
- They seem to parallel the timing of paratethys closure but how??/
- Youngest volcano is essentially active


Volcano-geomorphic sketch map of the Ciomadul (Csomád) volcano
0
1
2 km
Pilisca (Piliske) volcano
Olt
Haramul Mic (Kis-Haram)
P. Tusnad (Tusnád-p.)
Haramul Mare (Nagy-Haram)
Haramul Ierbos (Fü-Haram)
Vf. Cetăţii (Vár-tető)
Vf. Surduc (Szurdok-tető)
Ciomadul (Csomád) volcano
P. Ciomadul (Veres-p.)
Vf. Comloş (Komlós-tető)
Ciomadul Mare (Nagy-Csomád)
Muntele Puturosu (Büdös-hegy)
Dealul Taţa (Taca)
Piscul Pietros (Köves-Ponk)
P. Jambor (Zsombor-p.)
Heghieşul Mare (Nagy-Hegyes)
m (a.s.l.)
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
750
700
650
600
lava domes and flow lobes
lava flows
central lava dome complex
debris-flow surfaces
surfaces of pyro-clastic deposits
proposed older, larger crater; crater rim and wall
valley, water course



Persani

- Basaltic magmatism in a medium size magmatic field near Racos
- Mantle -derived
- Probably related to the Vrancea slab


25°E
45°N
Sărata
Hegheş
Racoş
site 1
1221ka
604ka
Mateiaş
Olt Valley
Turzun
Măguricea
Hoghiz
1062ka
Boroşa
799ka
1060ka
Grulu
site 2
800ka
683ka
Pietrele
Comana
1142ka
site 3
0
2,5
5km
LEGEND
1
2
3
4
5
6
7

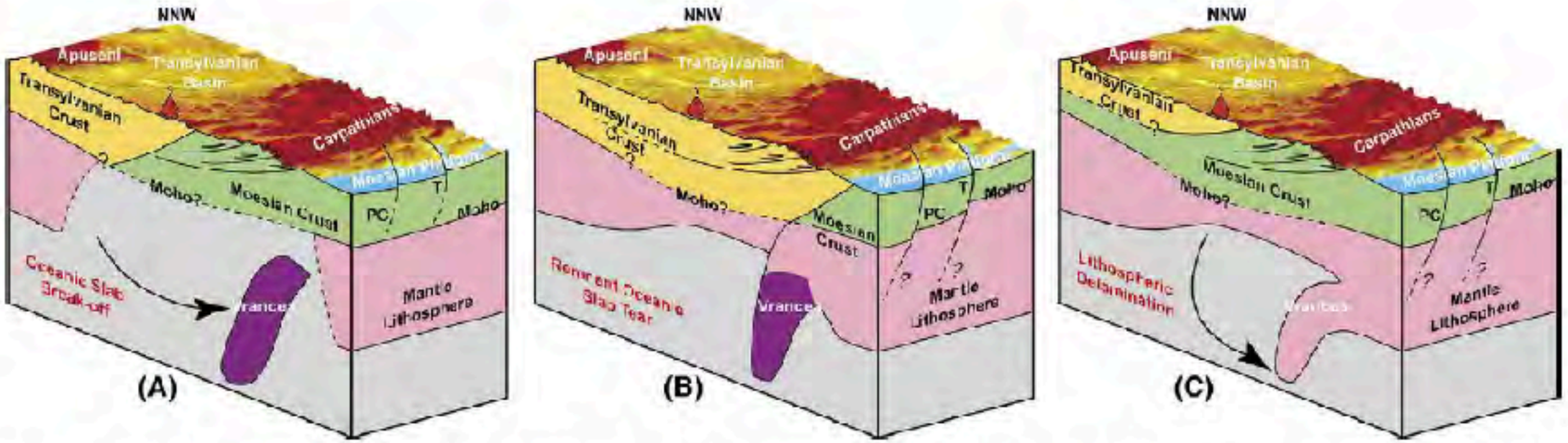
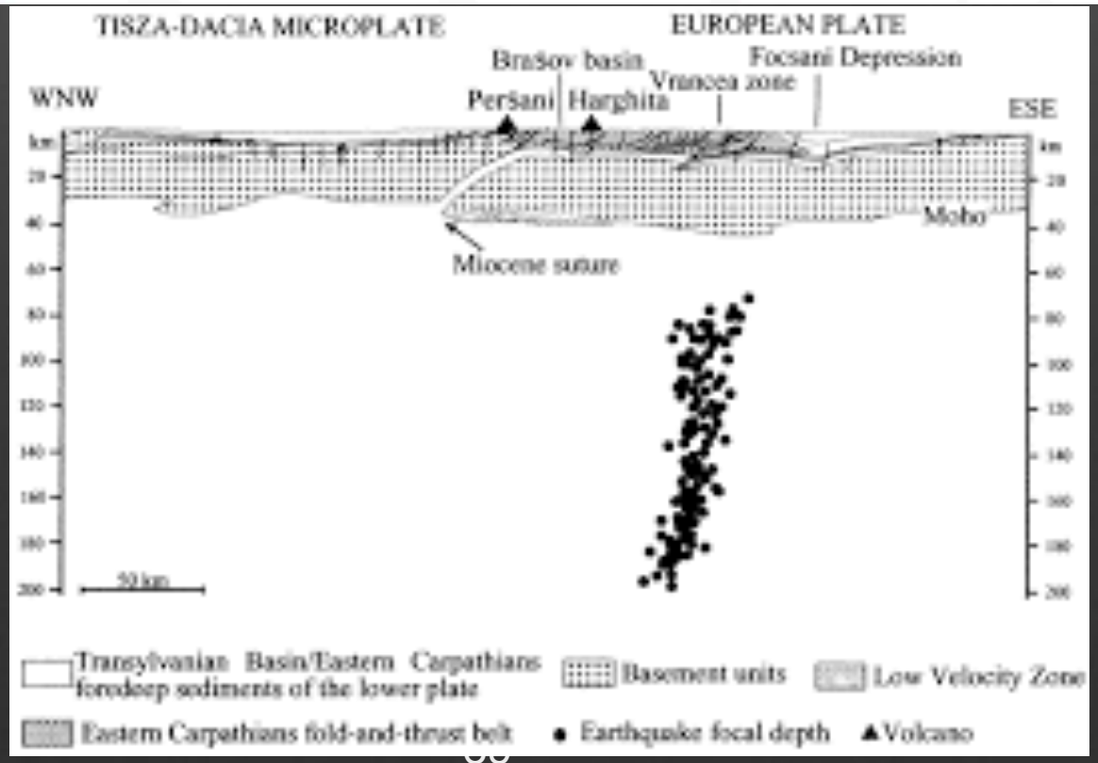


Fig. 6. 3-D perspective lithosphere-scale block models (view towards NNW), illustrating contrasting scenarios for geodynamic setting of the Vrancea zone. (A) Oceanic slab subduction and break-off. (B) Oceanic slab subduction and progressive lateral tear within the Carpathian foreland. (C) Continental lithospheric delamination. Green = Moesian/East European crust; yellow = Transylvanian crust; pink = continental mantle lithosphere; purple = oceanic lithosphere; grey = asthenosphere. Vrancea zone is located in lower front corner of models. See text for discussion.



Delamination?

- Roll back of lithosphere and detachment
- Makes way for mantle upwelling and melting
- Currently tested by our team


Photo by Jay Quade


FIELD
GEOLOGIST
WE SOLVE PROBLEMS
YOU DIDN'T KNOW YOU HAD
IN WAYS YOU DON'T
UNDERSTAND


KEEP
CALM
AND LET THE
FIELD
GEOLOGIST
HANDLE IT