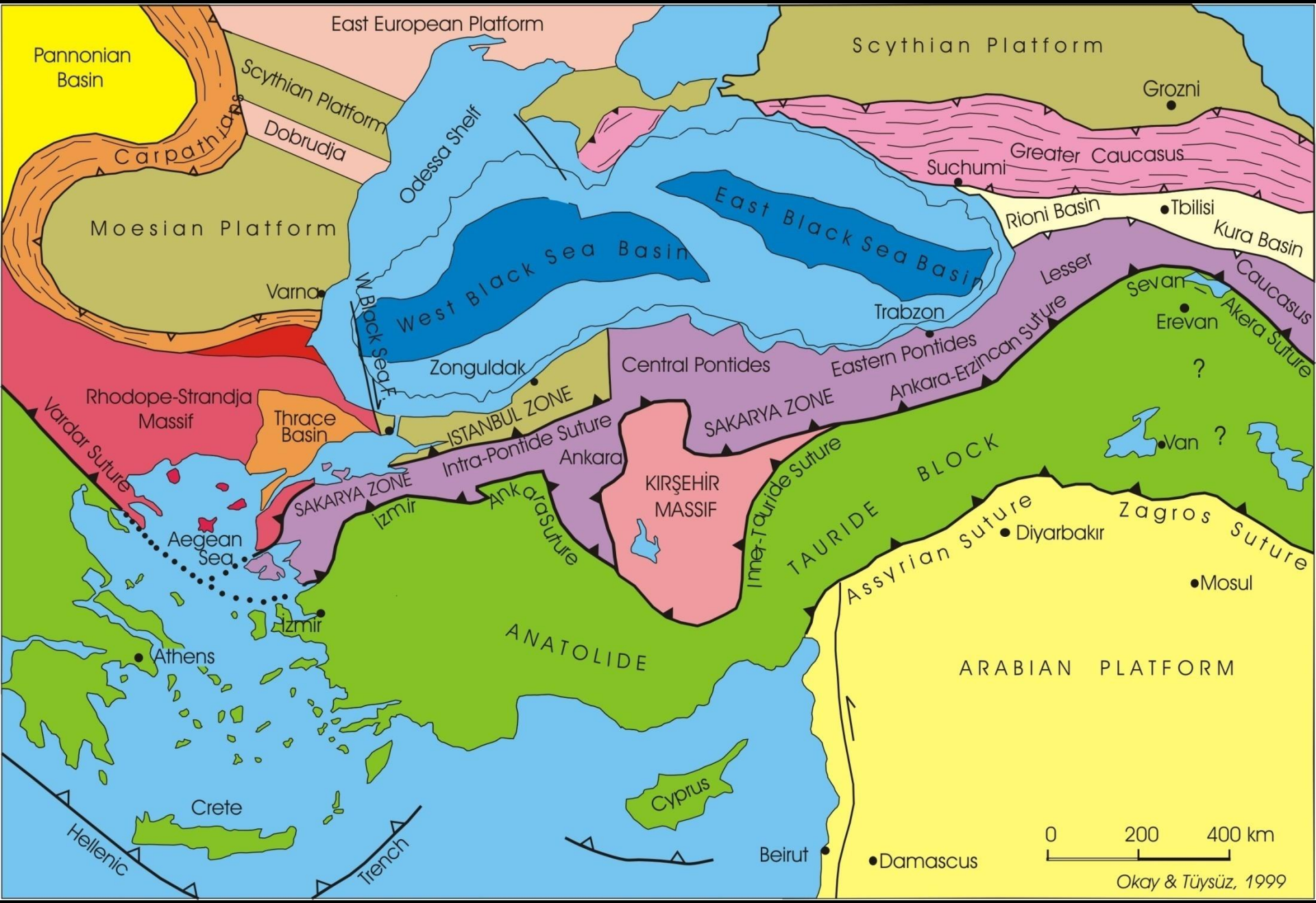
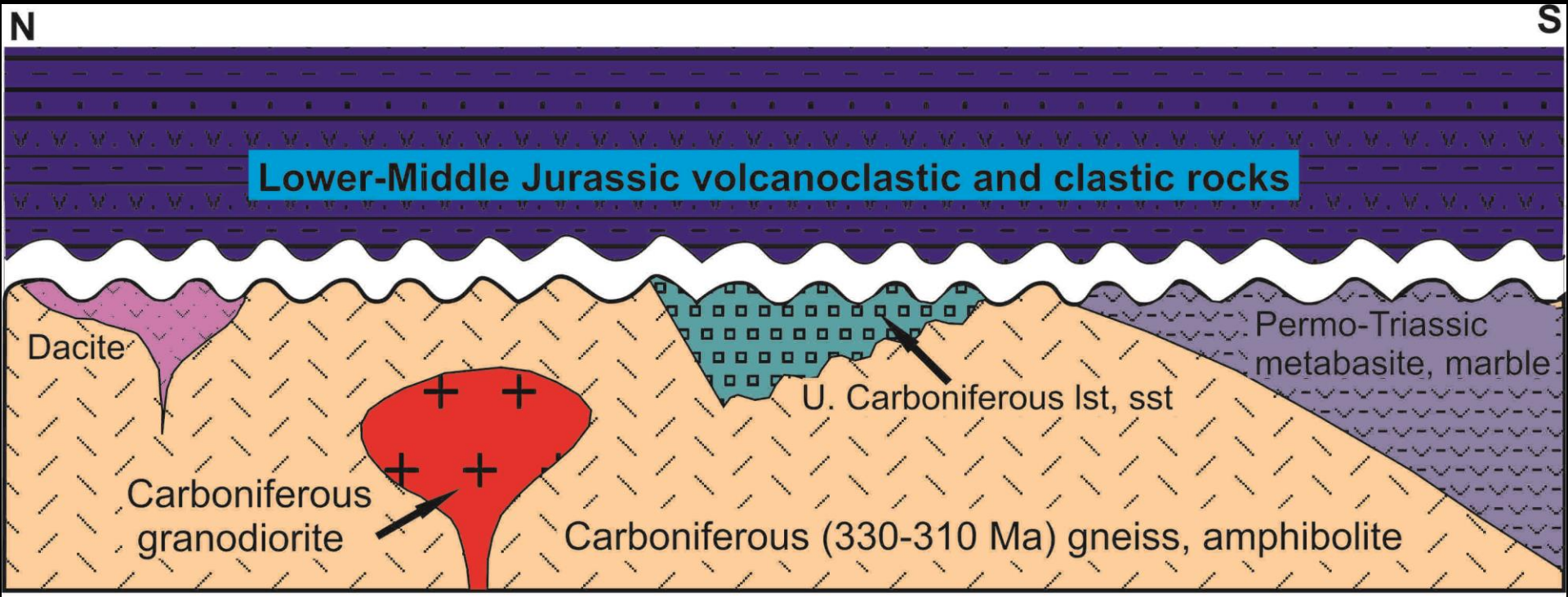
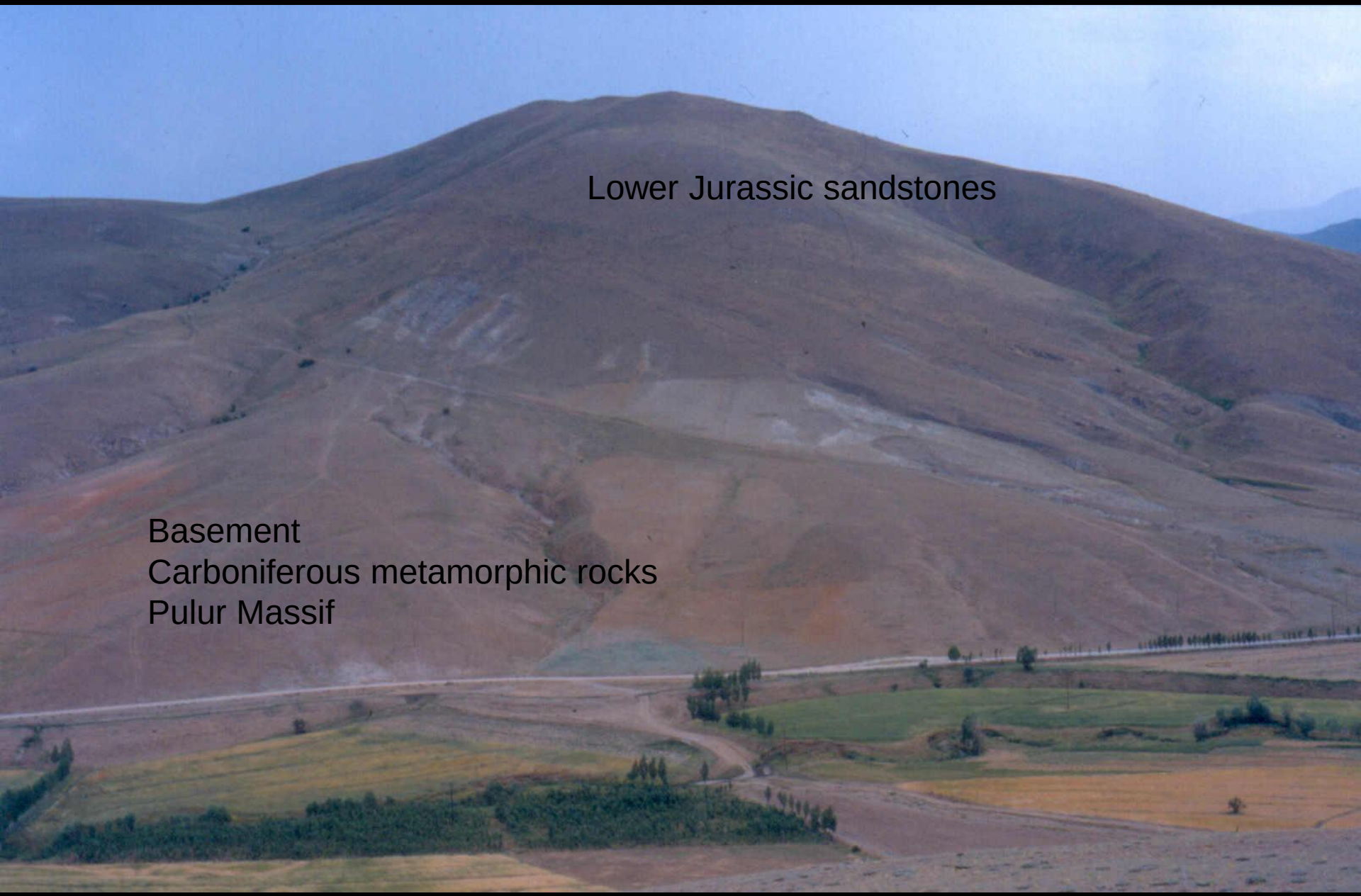
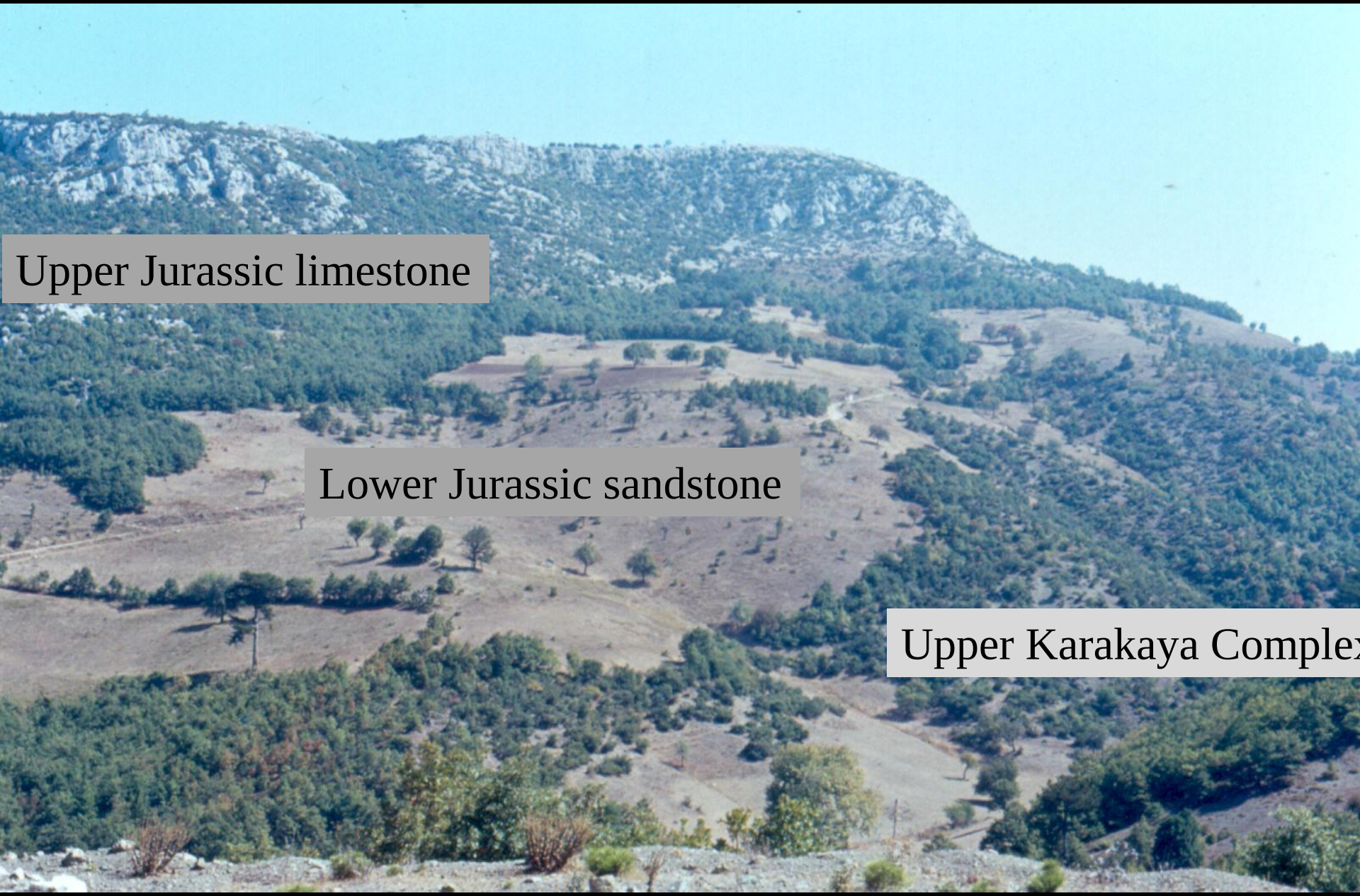
Post-Triassic evolution of the Sakarya Zone

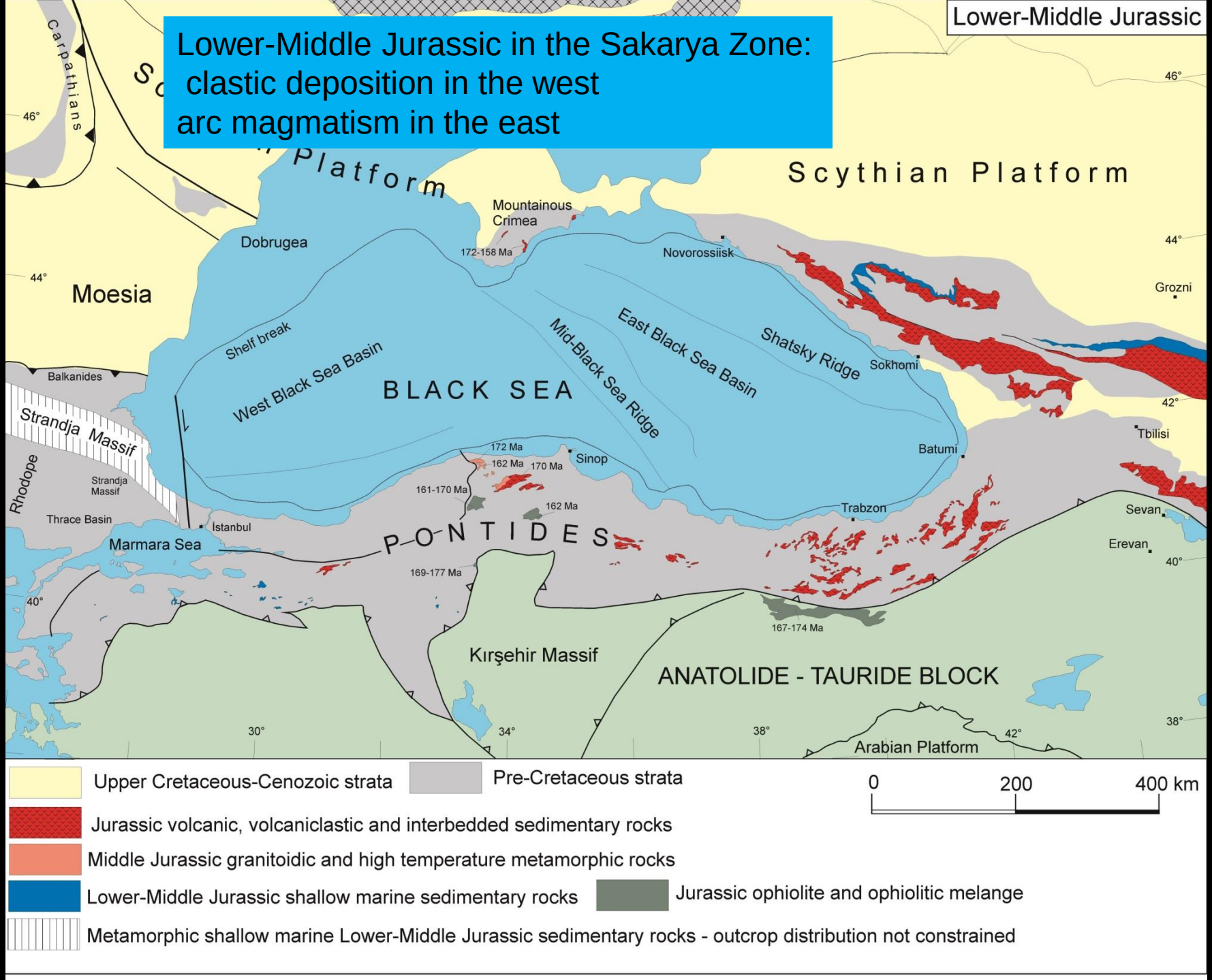

East European Platform
Scythian Platform
Pannonian Basin
Carpathians
Dobrudja
Moesian Platform
Varna
Odessa Shelf
West Black Sea Basin
East Black Sea Basin
W. Black Sea f.
Zonguldak
Trabzon
Grozni
Suchumi
Greater Caucasus
Rioni Basin
Tbilisi
Kura Basin
Lesser Caucasus
Sevan
Akera Suture
Erevan
Eastern Pontides
Ankara-Erzincan Suture
Central Pontides
SAKARYA ZONE
ISTANBUL ZONE
Intra-Pontide Suture
Ankara
KIRŞEHİR MASSIF
Inner-Tauride Suture
TAURIDE BLOCK
Van
Rhodope-Strandja Massif
Thrace Basin
Vardar Suture
Aegean Sea
İzmir
Ankara Suture
Assyrian Suture
Diyarbakır
Zagros Suture
Mosul
ANATOLIDE
ARABIAN PLATFORM
Athens
Crete
Hellenic Trench
Cyprus
Beirut
Damascus
0 200 400 km
Okay & Tüysüz, 1999

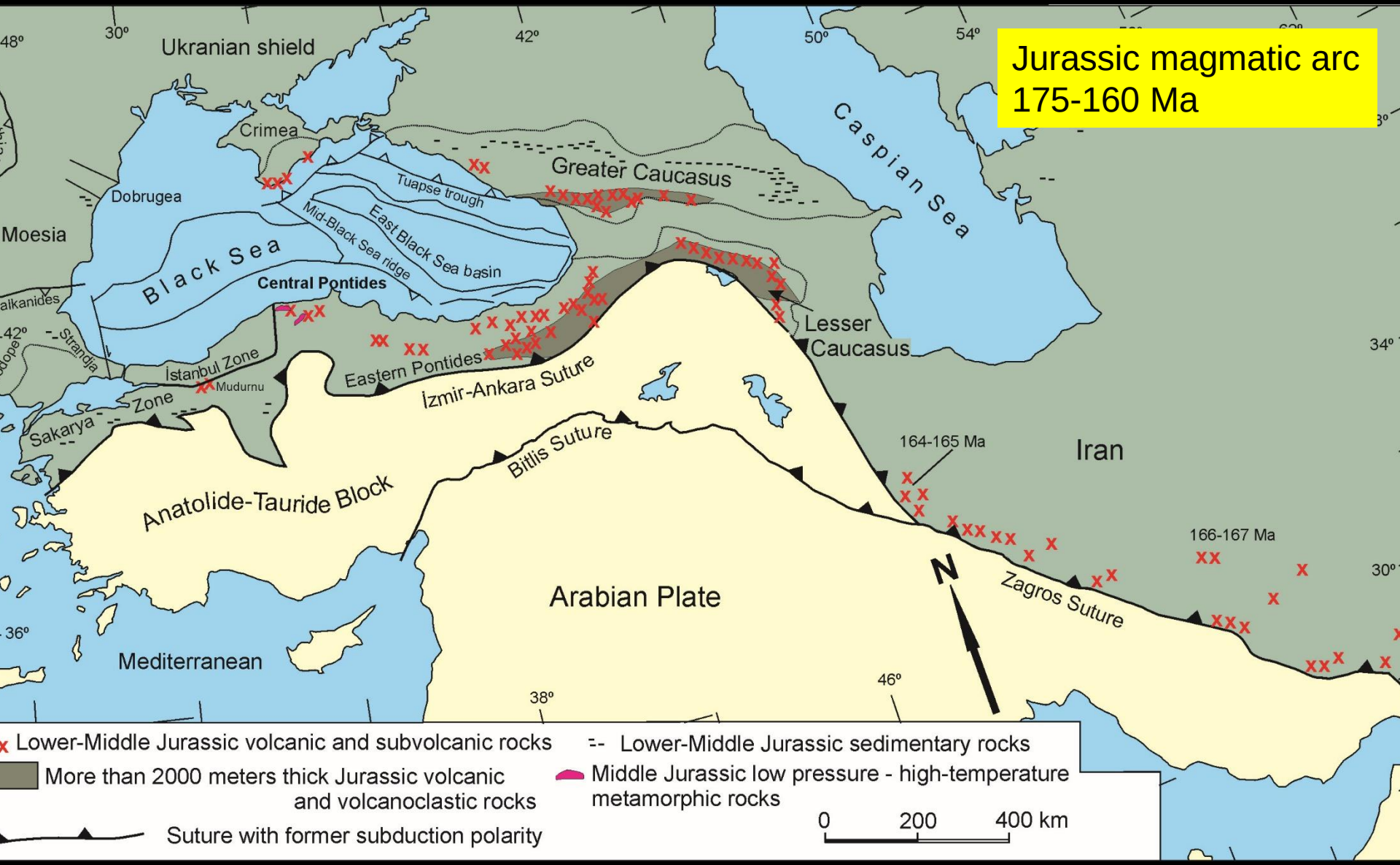


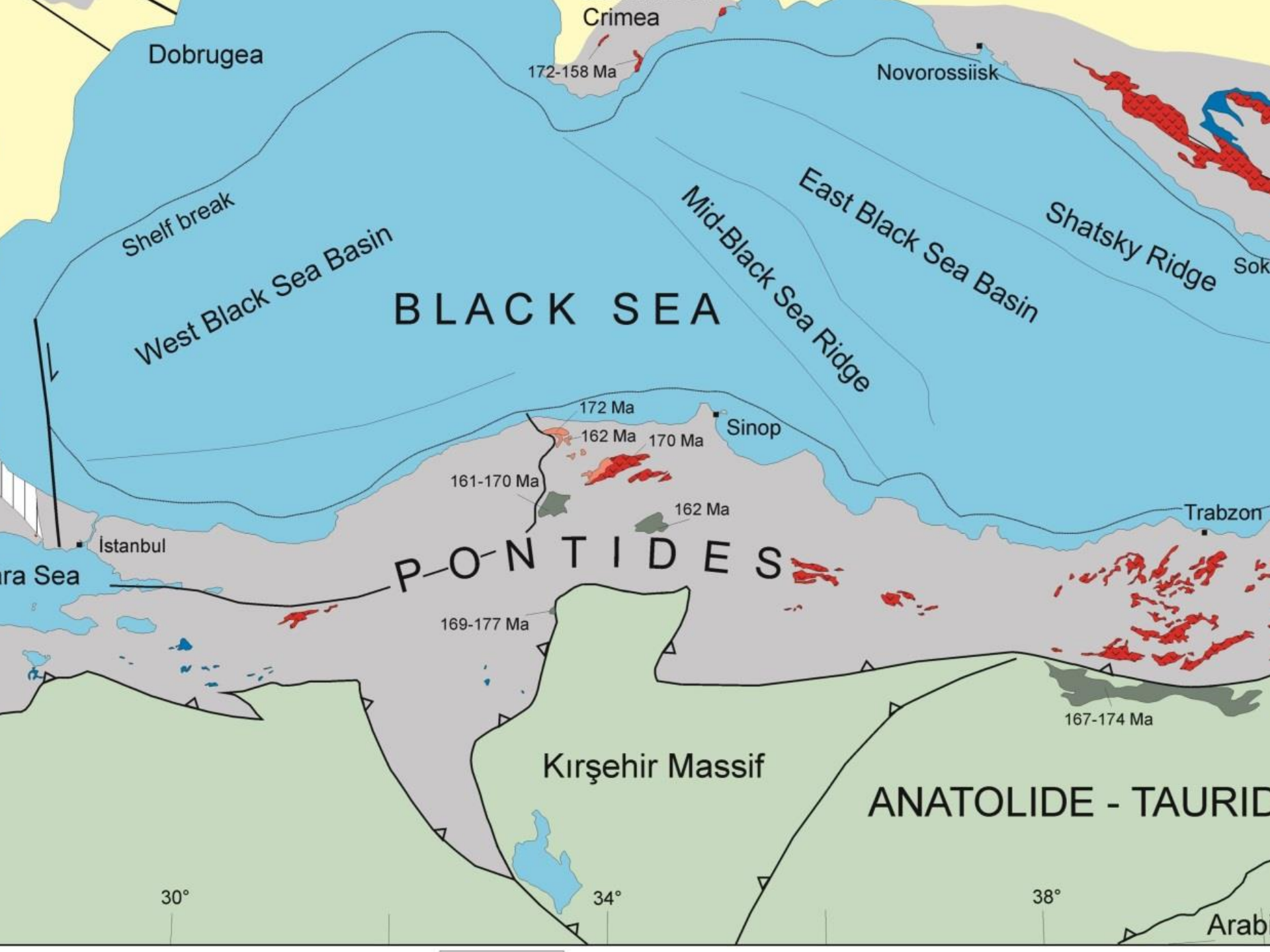
Pre-Jurassic basement units in the Eastern Pontides


Lower Jurassic sandstones
Basement
Carboniferous metamorphic rocks
Pulur Massif

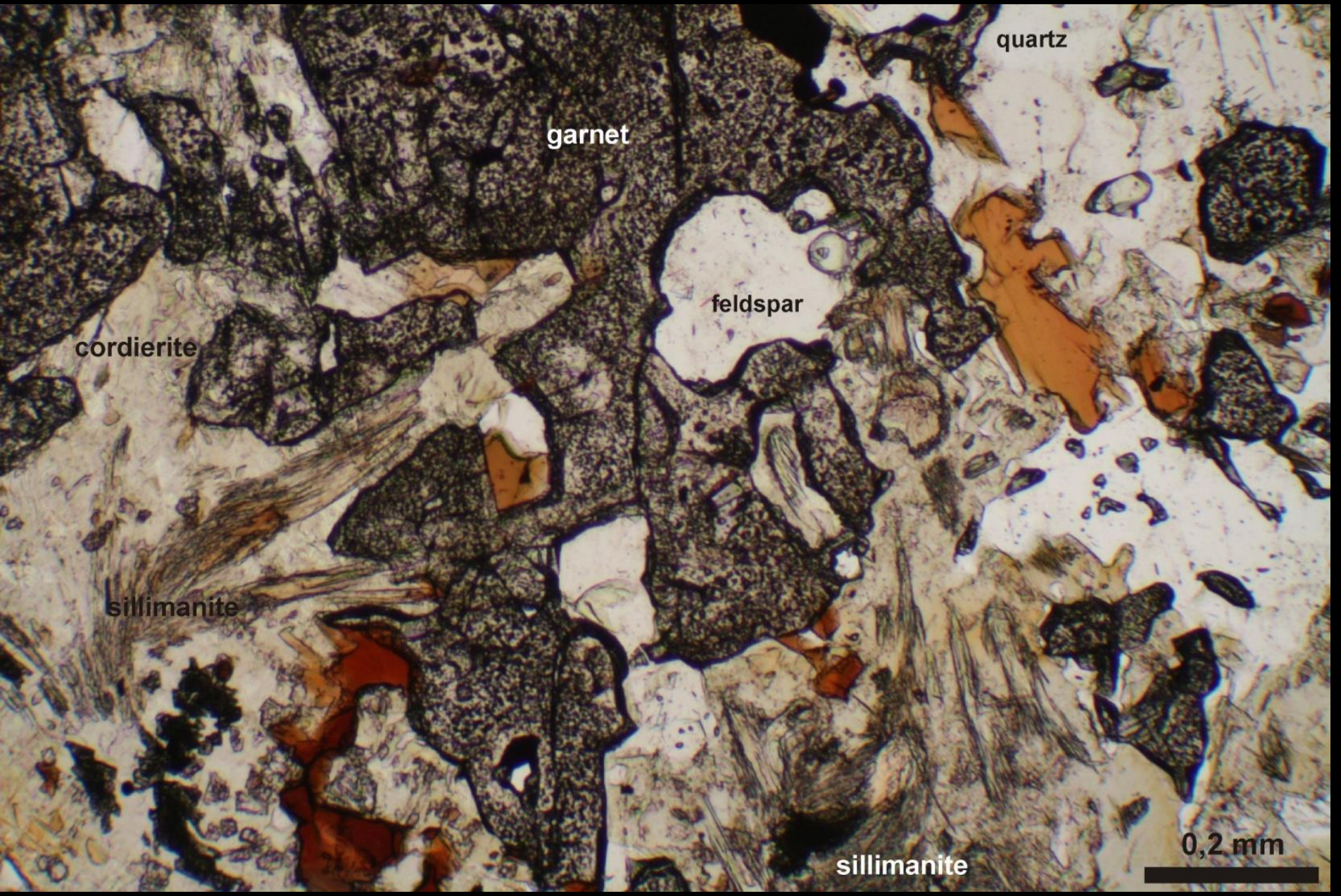

Upper Jurassic limestone
Lower Jurassic sandstone
Upper Karakaya Complex


Lower-Middle Jurassic
Lower-Middle Jurassic in the Sakarya Zone:
clastic deposition in the west
arc magmatism in the east
Carpathians
Scythian Platform
Mountainous Crimea
172-158 Ma
Dobrugea
Novorossiisk
Moesia
Grozni
Shelf break
West Black Sea Basin
BLACK SEA
Mid-Black Sea Ridge
East Black Sea Basin
Shatsky Ridge
Sokhomi
Balkanides
Strandja Massif
Rhodope
Strandja Massif
Thrace Basin
İstanbul
Marmara Sea
172 Ma
162 Ma
170 Ma
Sinop
161-170 Ma
162 Ma
Batumi
Tbilisi
Trabzon
Sevan
Erevan
PONTIDES
169-177 Ma
167-174 Ma
Kırşehir Massif
ANATOLIDE - TAURIDE BLOCK
Arabian Platform
46°
44°
42°
40°
38°
30°
34°
38°
42°
Upper Cretaceous-Cenozoic strata
Pre-Cretaceous strata
0
200
400 km
Jurassic volcanic, volcaniclastic and interbedded sedimentary rocks
Middle Jurassic granitoidic and high temperature metamorphic rocks
Lower-Middle Jurassic shallow marine sedimentary rocks
Jurassic ophiolite and ophiolitic melange
Metamorphic shallow marine Lower-Middle Jurassic sedimentary rocks - outcrop distribution not constrained

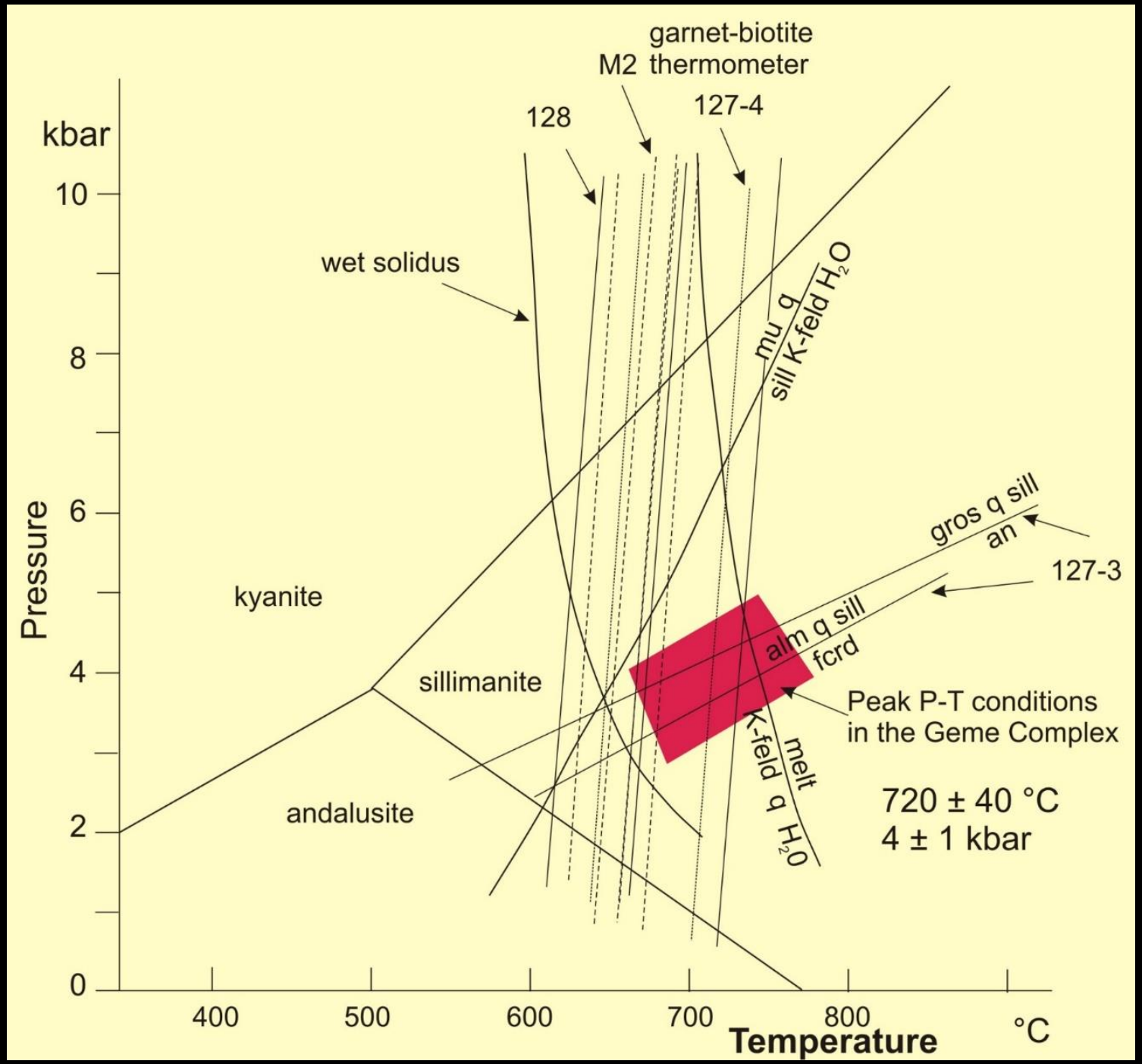

Jurassic magmatic arc
175-160 Ma
Ukranian shield
Crimea
Dobrugea
Moesia
Black Sea
Tuapse trough
Mid-Black Sea ridge
East Black Sea basin
Central Pontides
Greater Caucasus
Caspian Sea
Lesser Caucasus
Eastern Pontides
İzmir-Ankara Suture
İstanbul Zone
Mudurnu
Zone
Sakarya
Strandja
Anatolide-Tauride Block
Bitlis Suture
Arabian Plate
Mediterranean
Iran
164-165 Ma
166-167 Ma
Zagros Suture
N
48º
30º
42º
50º
54º
34º
30º
36º
38º
46º
Lower-Middle Jurassic volcanic and subvolcanic rocks
Lower-Middle Jurassic sedimentary rocks
More than 2000 meters thick Jurassic volcanic and volcanoclastic rocks
Middle Jurassic low pressure - high-temperature metamorphic rocks
Suture with former subduction polarity
0
200
400 km

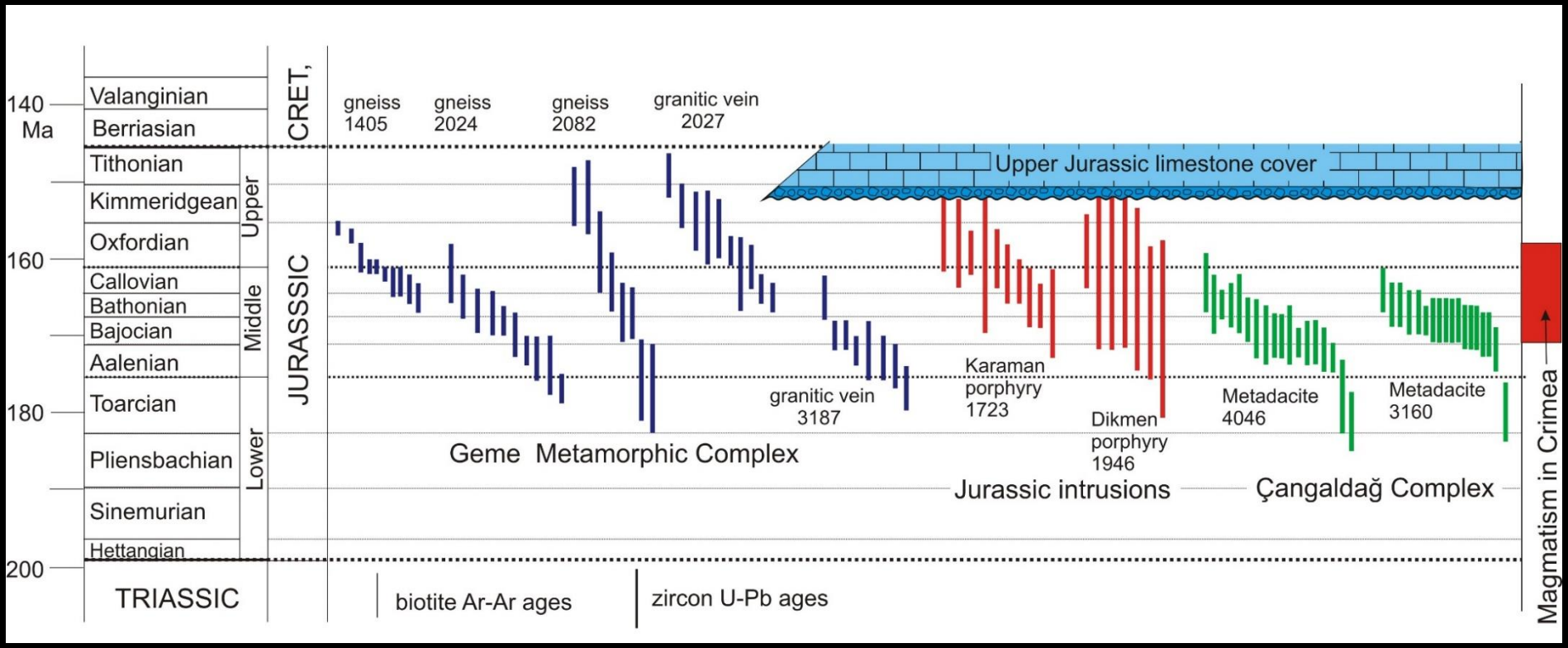

Crimea
Dobrugea
172-158 Ma
Novorossiisk
Shelf break
West Black Sea Basin
BLACK SEA
Mid-Black Sea Ridge
East Black Sea Basin
Shatsky Ridge
Sok
172 Ma
162 Ma
170 Ma
Sinop
161-170 Ma
162 Ma
Trabzon
İstanbul
ra Sea
PONTIDES
169-177 Ma
167-174 Ma
Kırşehir Massif
ANATOLIDE - TAURID
30°
34°
38°
Arab

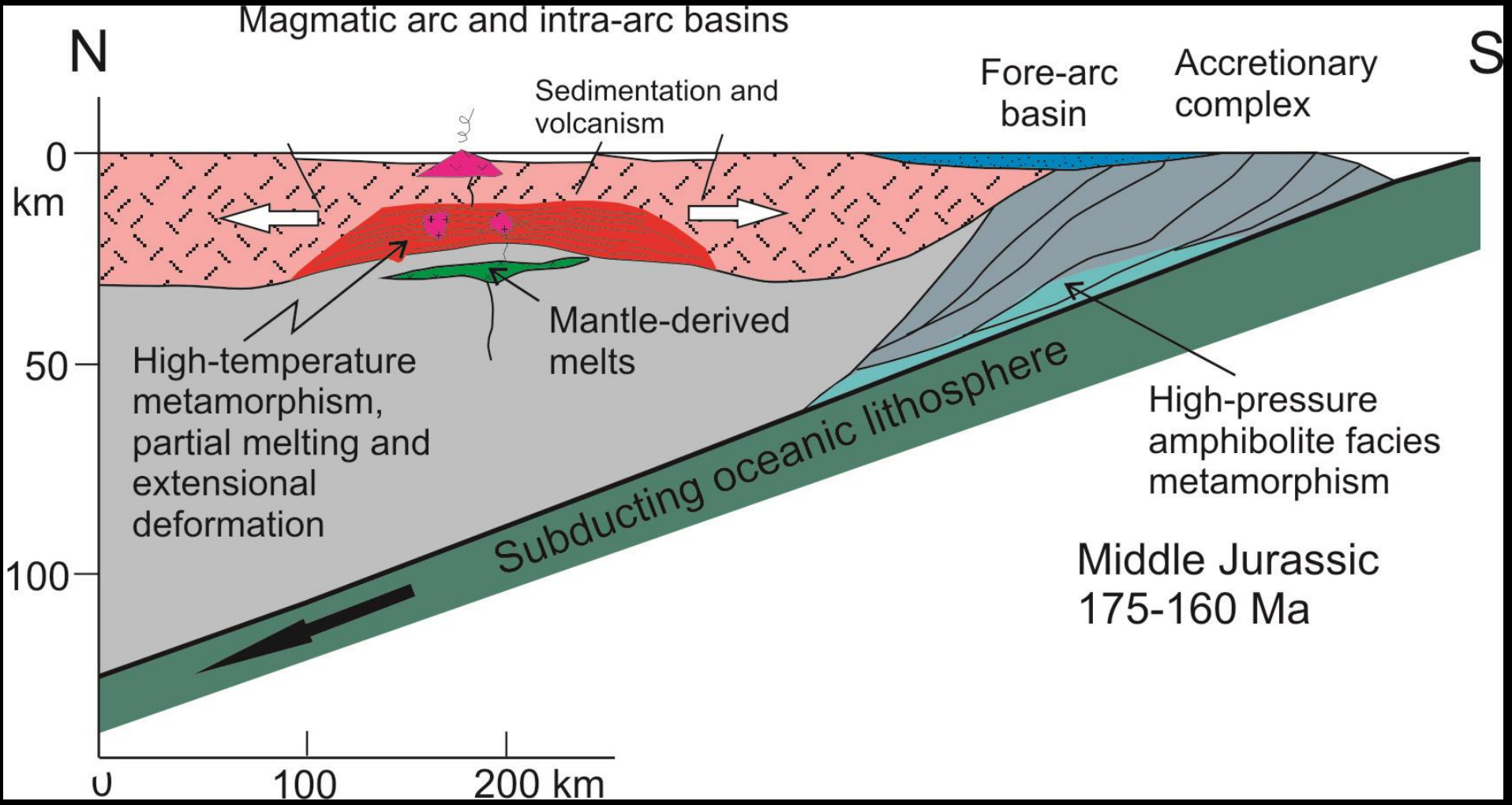

Migmatitic gneiss
Central Pontides, İnebolu region

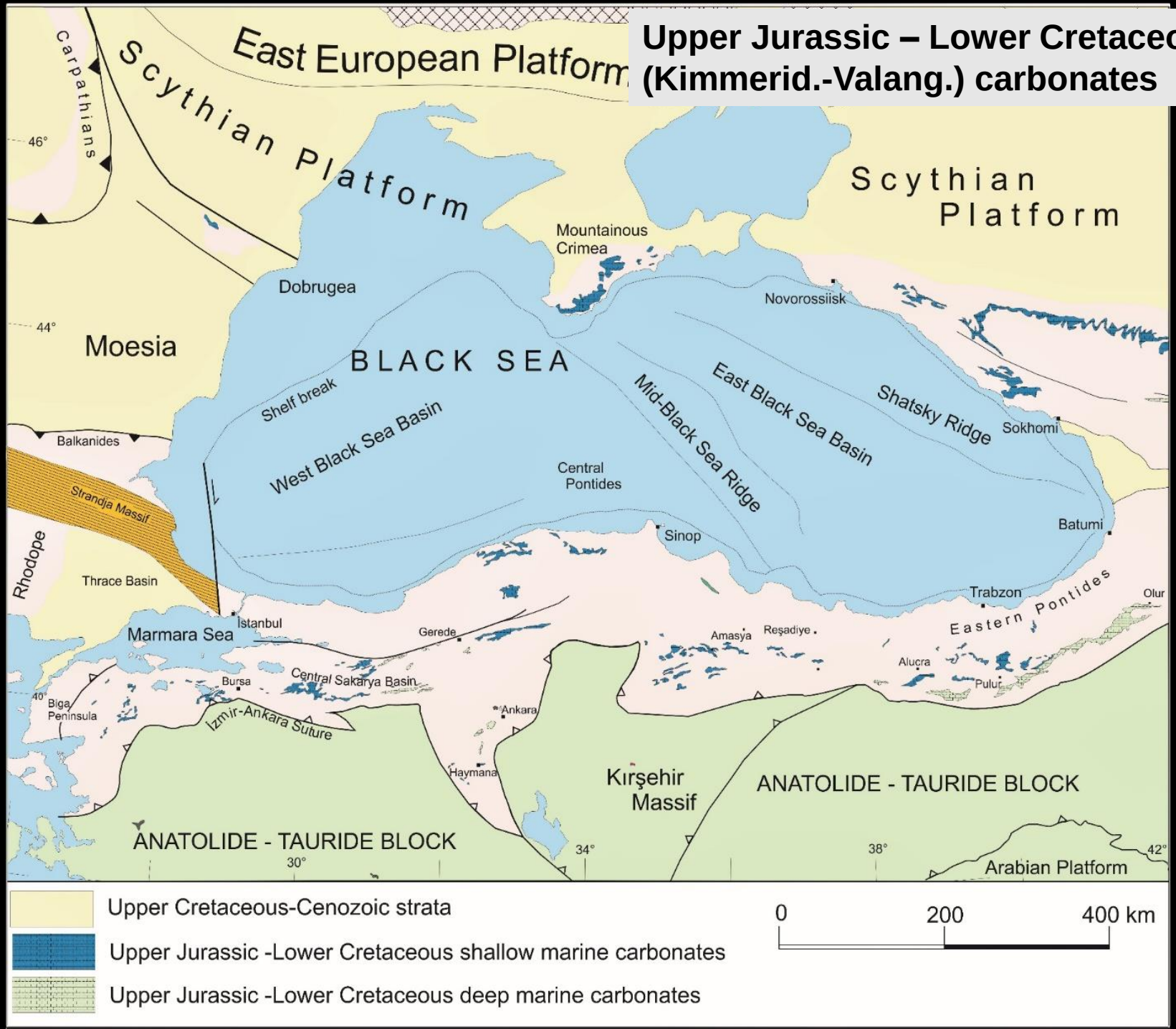


cordierite + garnet+ sillimanite + biotite + plagloclase + K-feldspar + quartz


garnet-biotite
M2 thermometer
128
127-4
kbar
10
8
6
4
2
0
Pressure
wet solidus
mu q
sill K-feld H_2O
gros q sill
an
127-3
kyanite
alm q sill
fcrd
sillimanite
Peak P-T conditions
in the Geme Complex
K-feld q melt
H_2O
andalusite
720 ± 40 °C
4 ± 1 kbar
400
500
600
700
800
°C
Temperature

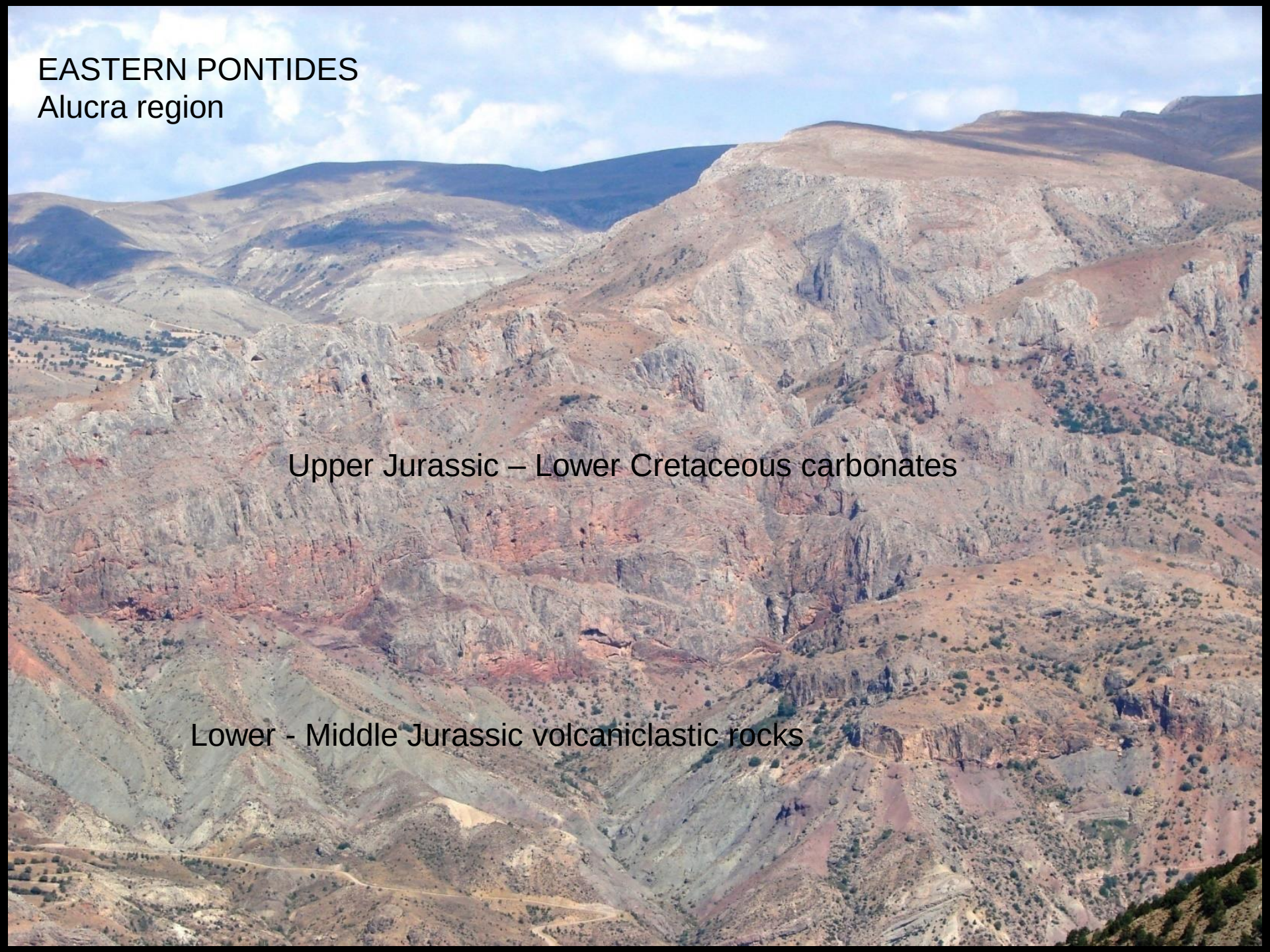

140 Ma
160
180
200
Valanginian
Berriasian
Tithonian
Kimmeridgean
Oxfordian
Callovian
Bathonian
Bajocian
Aalenian
Toarcian
Pliensbachian
Sinemurian
Hettangian
Upper
Middle
Lower
CRET,
JURASSSIC
TRIASSIC
gneiss 1405
gneiss 2024
gneiss 2082
granitic vein 2027
Upper Jurassic limestone cover
granitic vein 3187
Karaman porphyry 1723
Dikmen porphyry 1946
Metadacite 4046
Metadacite 3160
Geme Metamorphic Complex
Jurassic intrusions
Çangaldağ Complex
Magmatism in Crimea
biotite Ar-Ar ages
zircon U-Pb ages


Magmatic arc and intra-arc basins
N
S
Sedimentation and volcanism
Fore-arc basin
Accretionary complex
0
km
50
100
Mantle-derived melts
High-temperature metamorphism, partial melting and extensional deformation
Subducting oceanic lithosphere
High-pressure amphibolite facies metamorphism
Middle Jurassic
175-160 Ma
0
100
200 km


Upper Jurassic – Lower Cretaceous (Kimmerid.-Valang.) carbonates
East European Platform
Scythian Platform
Carpathians
Scythian Platform
Mountainous Crimea
Dobrugea
Novorossiisk
Moesia
BLACK SEA
Shelf break
West Black Sea Basin
Mid-Black Sea Ridge
East Black Sea Basin
Shatsky Ridge
Sokhomi
Balkanides
Central Pontides
Strandja Massif
Rhodope
Sinop
Batumi
Thrace Basin
Trabzon
Olur
Eastern Pontides
Istanbul
Marmara Sea
Gerede
Amasya
Reşadiye
Aluçra
Pulur
Central Sakarya Basin
Bursa
Biga Peninsula
Izmir-Ankara Suture
Ankara
Haymana
Kırşehir Massif
ANATOLIDE - TAURIDE BLOCK
ANATOLIDE - TAURIDE BLOCK
Arabian Platform
46°
44°
40°
30°
34°
38°
42°
Upper Cretaceous-Cenozoic strata
Upper Jurassic -Lower Cretaceous shallow marine carbonates
Upper Jurassic -Lower Cretaceous deep marine carbonates
0
200
400 km

LATE JURASSIC – EARLY CRETACEOUS

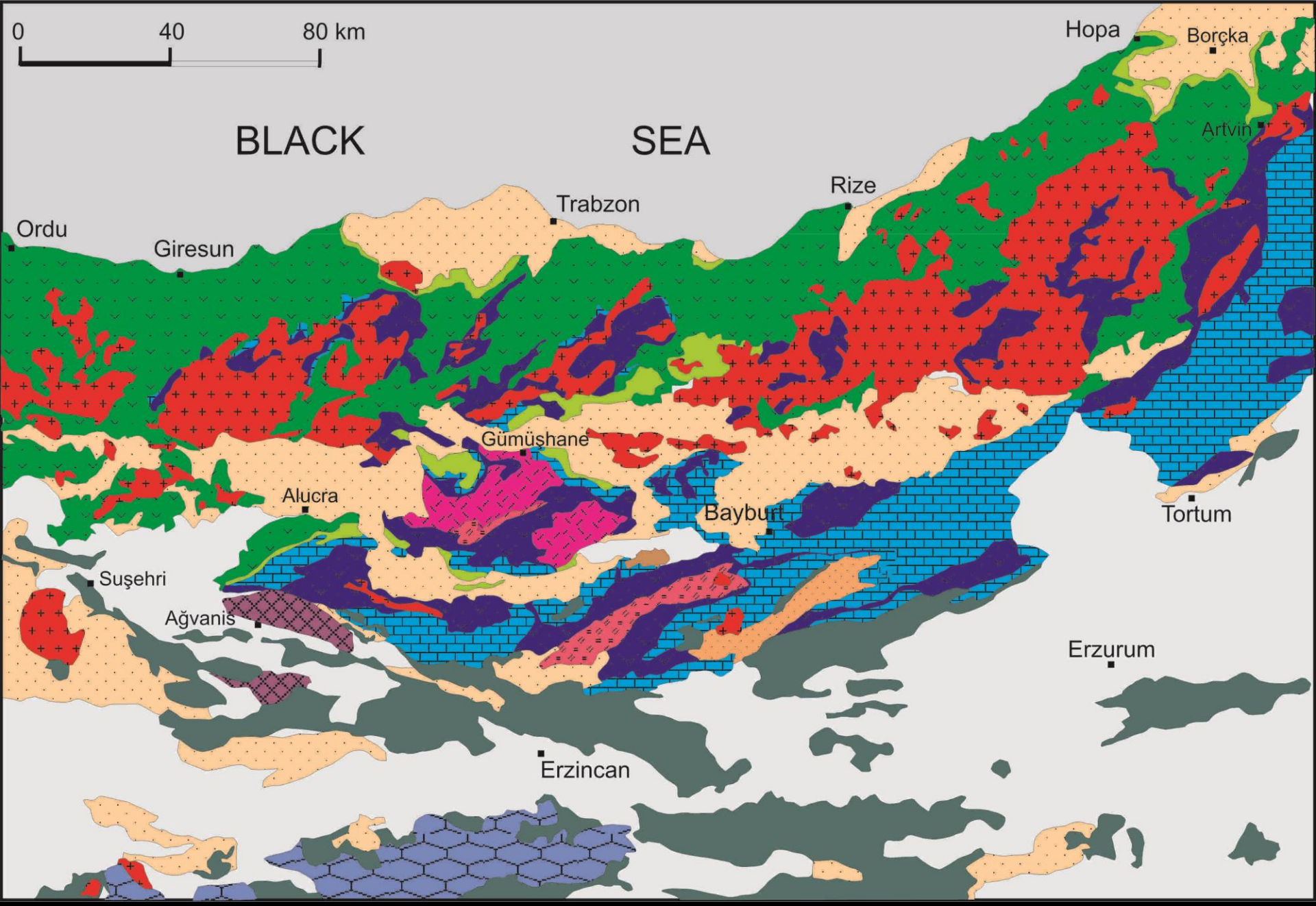
UBIQITOUS CARBONATE DEPOSITION THROUGHOUT THE PONTIDES

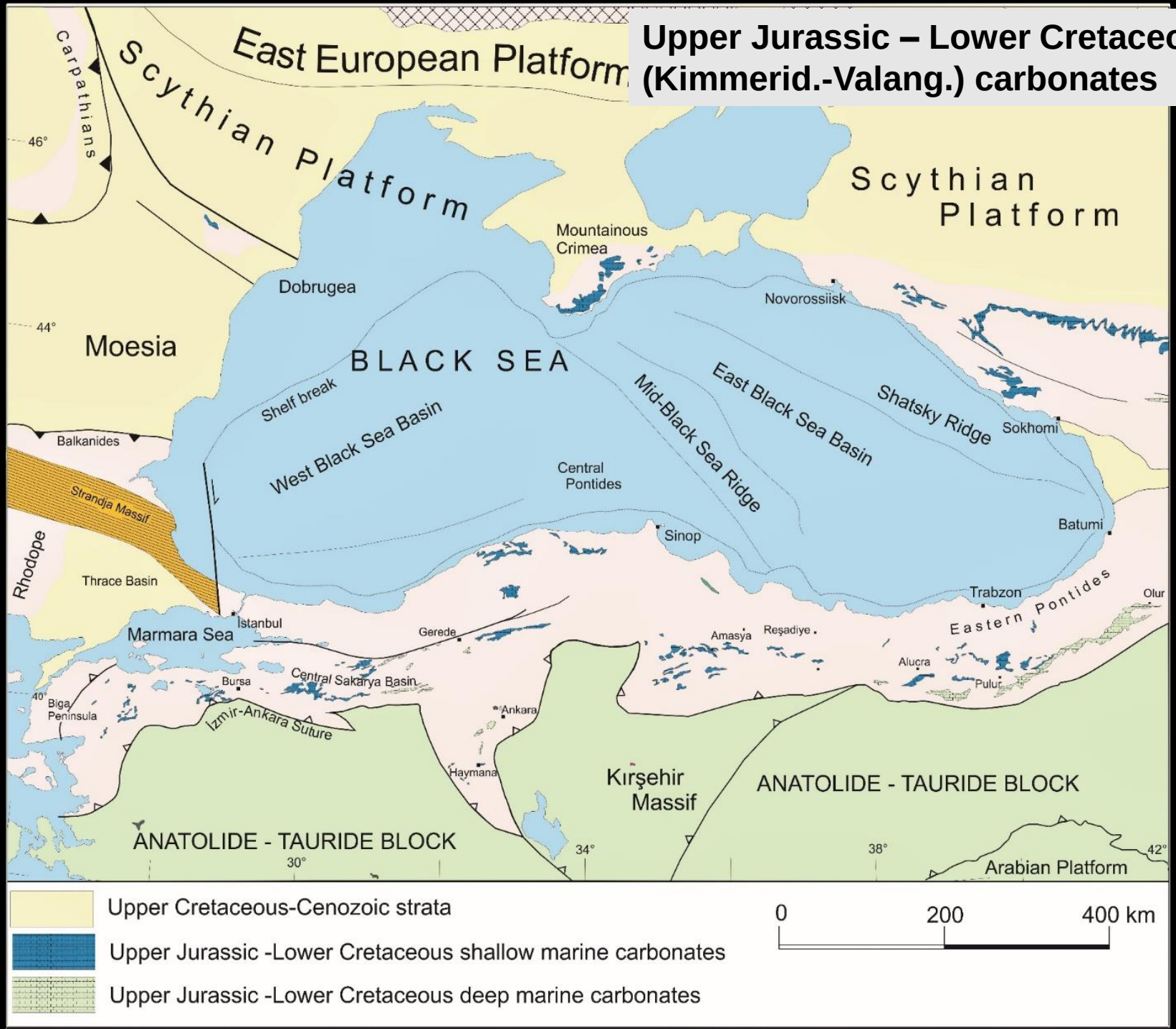

EASTERN PONTIDES
Alucra region
Upper Jurassic – Lower Cretaceous carbonates
Lower - Middle Jurassic volcaniclastic rocks

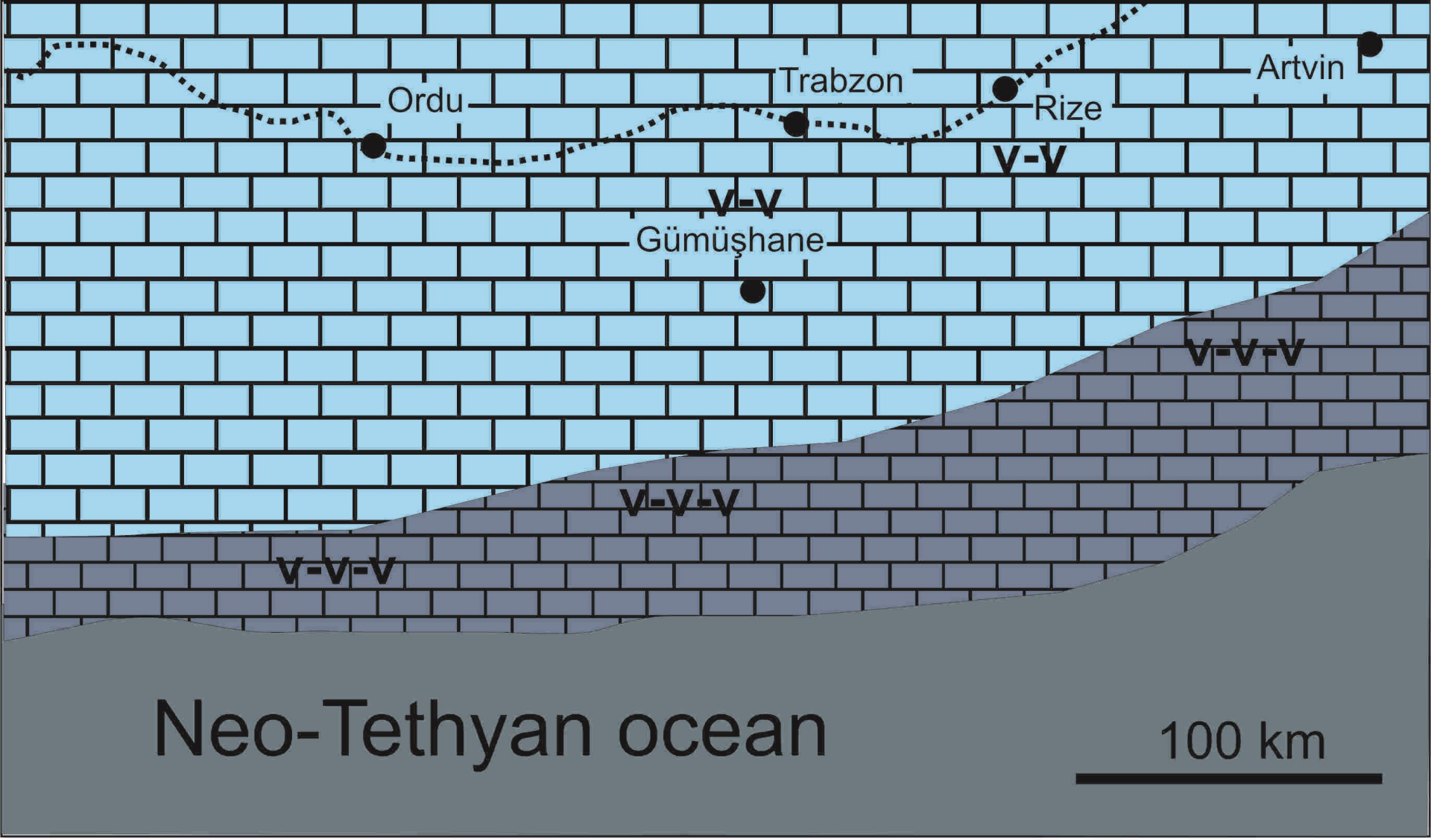
CENTRAL PONTIDES
Çangaldağ region


Upper Jurassic – Lower Cretaceous
(Kimmerid.-Valang.) carbonates
Dobrugea
BLACK SEA
Shelf break
West Black Sea Basin
Mid-Black Sea Ridge
East Black Se
Central
Pontides
Sinop
Sakarya Zone
İstanbul Zone
Gerede
Amasya
Reşadiye
Central Sakarya Basin


İnaltı Formasyonu
Üst Jura – Alt Kretase
Akgöl Formasyonu
Üst Triyas - ? Alt Liyas)


0
40
80 km
BLACK
SEA
Hopa
Borçka
Artvin
Rize
Trabzon
Ordu
Giresun
Gümüşhane
Alucra
Bayburt
Tortum
Suşehri
Ağvanis
Erzurum
Erzincan

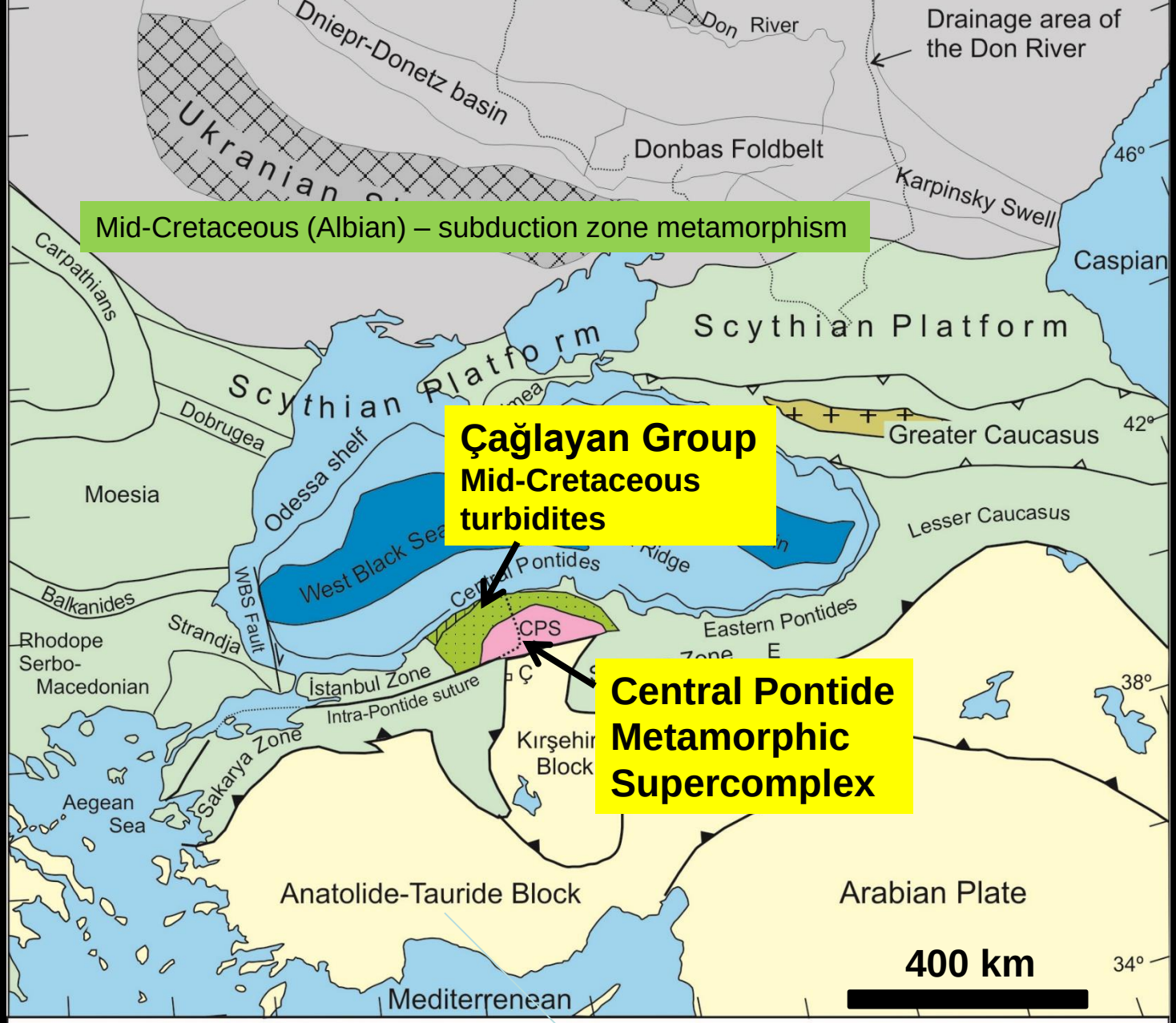

Upper Jurassic – Lower Cretaceous (Kimmerid.-Valang.) carbonates
East European Platform
Scythian Platform
Carpathians
Scythian Platform
Mountainous Crimea
Dobrugea
Novorossiisk
Moesia
BLACK SEA
Shelf break
West Black Sea Basin
Mid-Black Sea Ridge
East Black Sea Basin
Shatsky Ridge
Sokhomi
Balkanides
Central Pontides
Strandja Massif
Rhodope
Sinop
Batumi
Thrace Basin
Trabzon
Olur
Eastern Pontides
Istanbul
Marmara Sea
Gerede
Amasya
Reşadiye
Aluçra
Pulur
Central Sakarya Basin
Bursa
Biga Peninsula
Izmir-Ankara Suture
Ankara
Haymana
Kırşehir Massif
ANATOLIDE - TAURIDE BLOCK
ANATOLIDE - TAURIDE BLOCK
Arabian Platform
46°
44°
40°
30°
34°
38°
42°
Upper Cretaceous-Cenozoic strata
Upper Jurassic -Lower Cretaceous shallow marine carbonates
Upper Jurassic -Lower Cretaceous deep marine carbonates
0
200
400 km

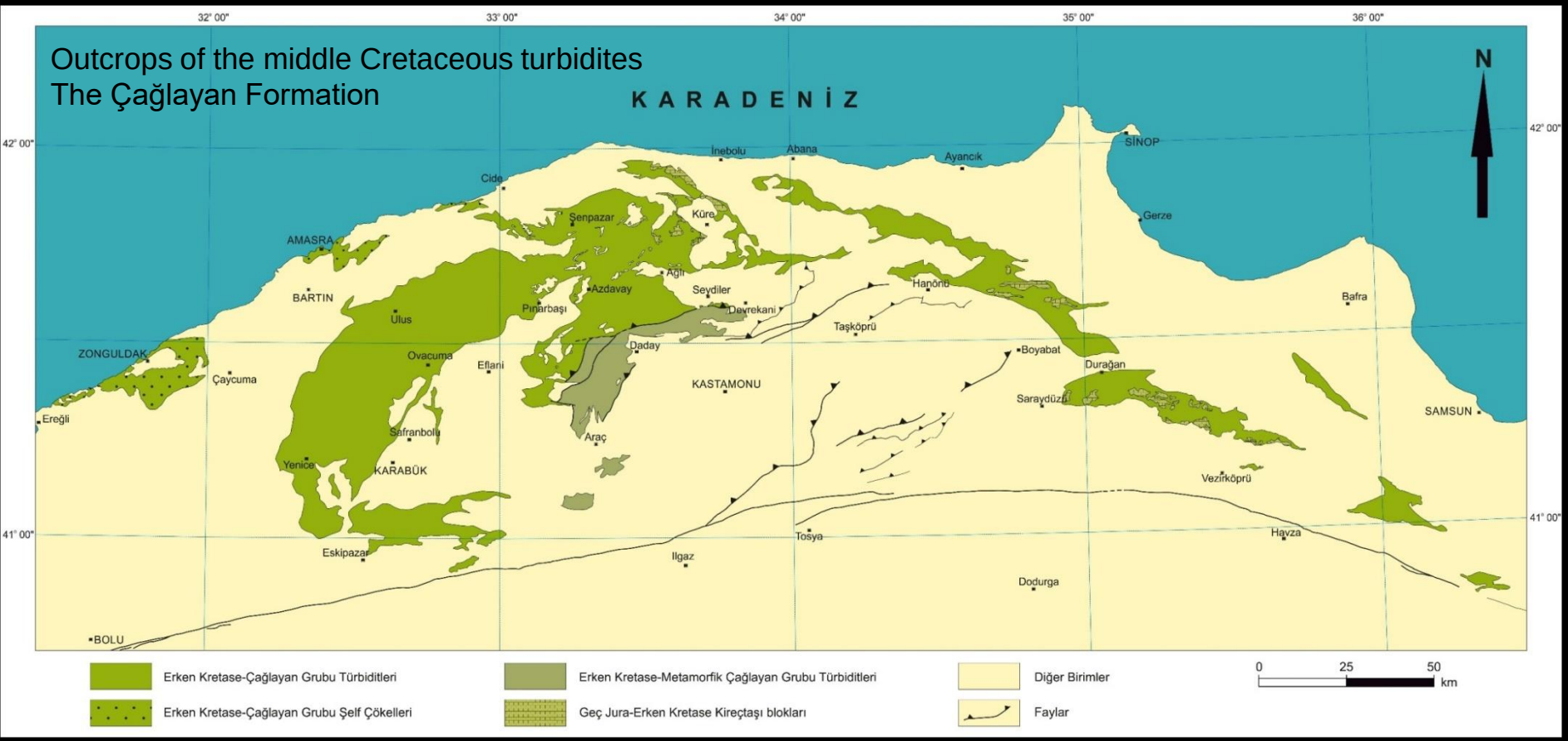


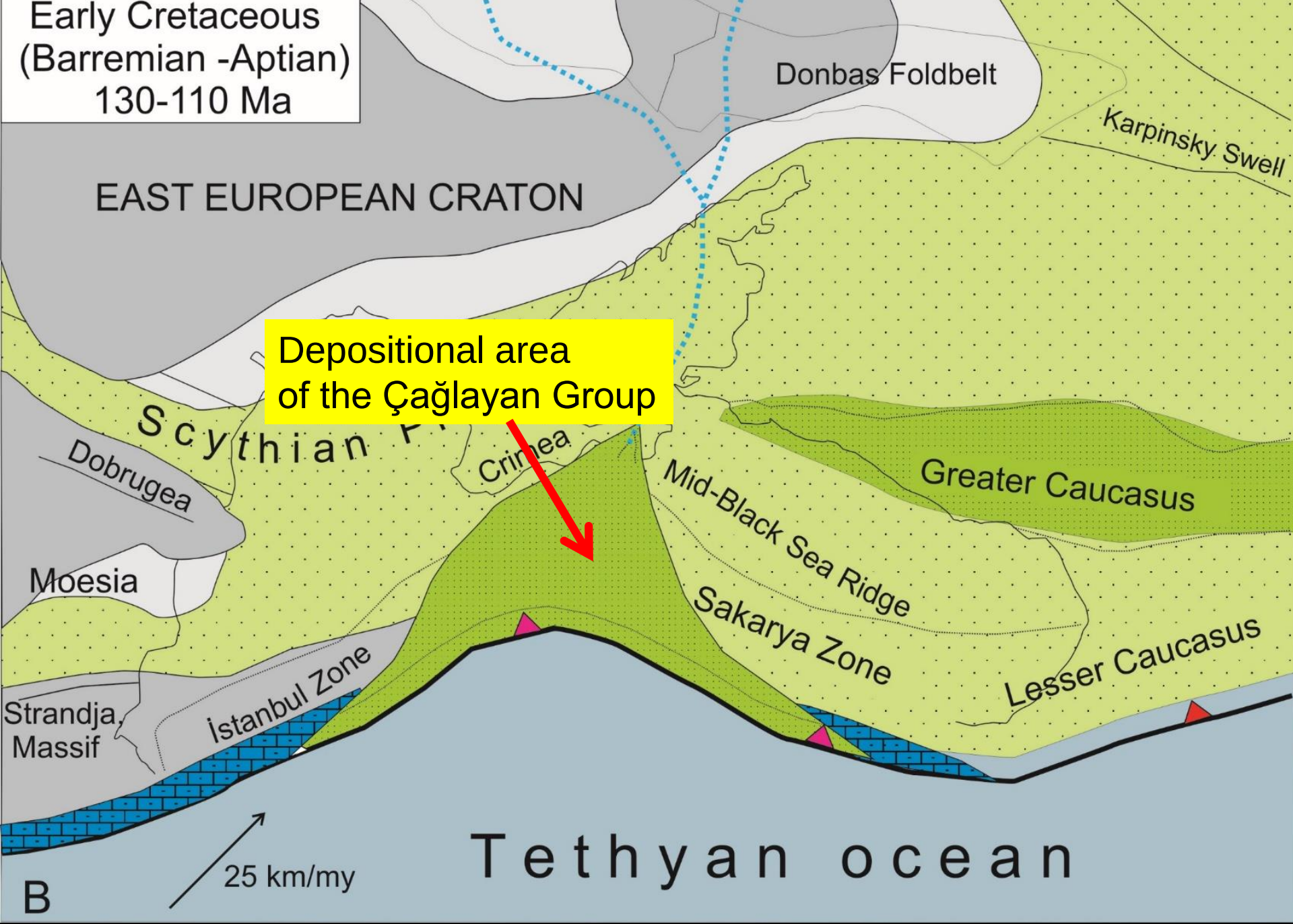
Early Cretaceous

Neritic limestone

Pelagic limestone, calciturbidite

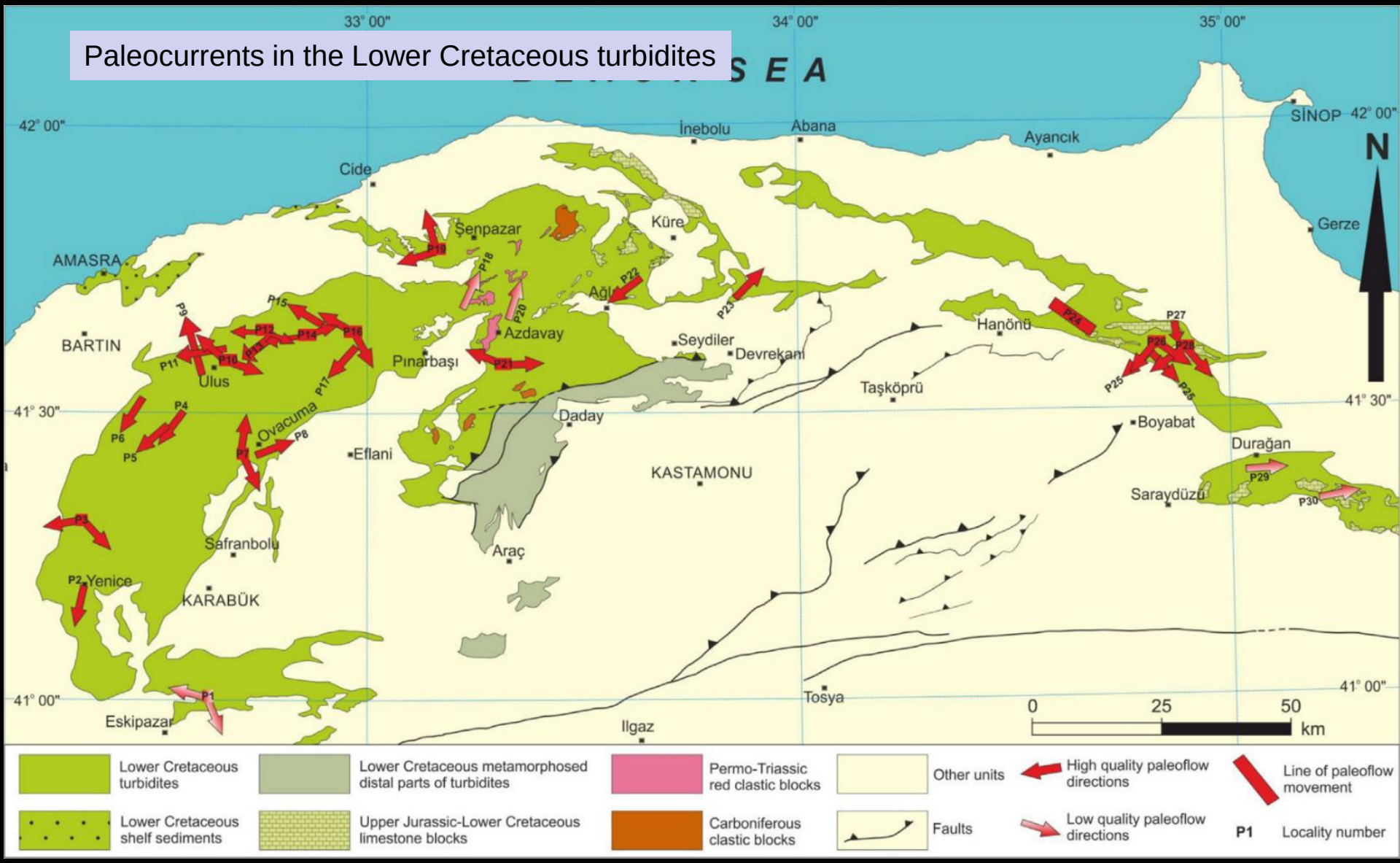

Mid-Cretaceous (Albian) – subduction zone metamorphism
Çağlayan Group
Mid-Cretaceous turbidites
Central Pontide Metamorphic Supercomplex
Dniepr-Donetz basin
Don River
Drainage area of the Don River
Donbas Foldbelt
Karpinsky Swell
Caspian
Carpathians
Scythian Platform
Dobrugea
Moesia
Odessa shelf
West Black Sea
Central Pontides
Greater Caucasus
Lesser Caucasus
Eastern Pontides
Balkanides
Strandja
WBS Fault
Rhodope Serbo-Macedonian
İstanbul Zone
Intra-Pontide suture
Sakarya Zone
CPS
Kırşehir Block
Aegean Sea
Anatolide-Tauride Block
Arabian Plate
Mediterranean
46°
42°
38°
34°
400 km
Phanerozoic cover
Paleoproterozoic-Archean basement
East European Craton (EEC)
Gondwana terranes accreted to EEC in the Paleozoic-early Mesozoic


Outcrops of the middle Cretaceous turbidites
The Çağlayan Formation
KARADENİZ
N
32° 00"
33° 00"
34° 00"
35° 00"
36° 00"
42° 00"
41° 00"
İnebolu
Abana
Ayancık
SİNOP
Cide
Şenpazar
Küre
Gerze
AMASRA
Ağlı
Azdavay
Seydiler
Hanönü
BARTIN
Ulus
Pınarbaşı
Devrekani
Bafra
Taşköprü
ZONGULDAK
Ovacuma
Daday
Boyabat
Durağan
Çaycuma
Eflani
KASTAMONU
Saraydüzü
Ereğli
SAMSUN
Safranbolu
Araç
Yenice
KARABÜK
Vezirköprü
Tosya
Havza
Eskipazar
Ilgaz
Dodurga
BOLU
Erken Kretase-Çağlayan Grubu Türbiditleri
Erken Kretase-Çağlayan Grubu Şelf Çökelleri
Erken Kretase-Metamorfik Çağlayan Grubu Türbiditleri
Geç Jura-Erken Kretase Kireçtaşı blokları
Diğer Birimler
Faylar
0
25
50
km

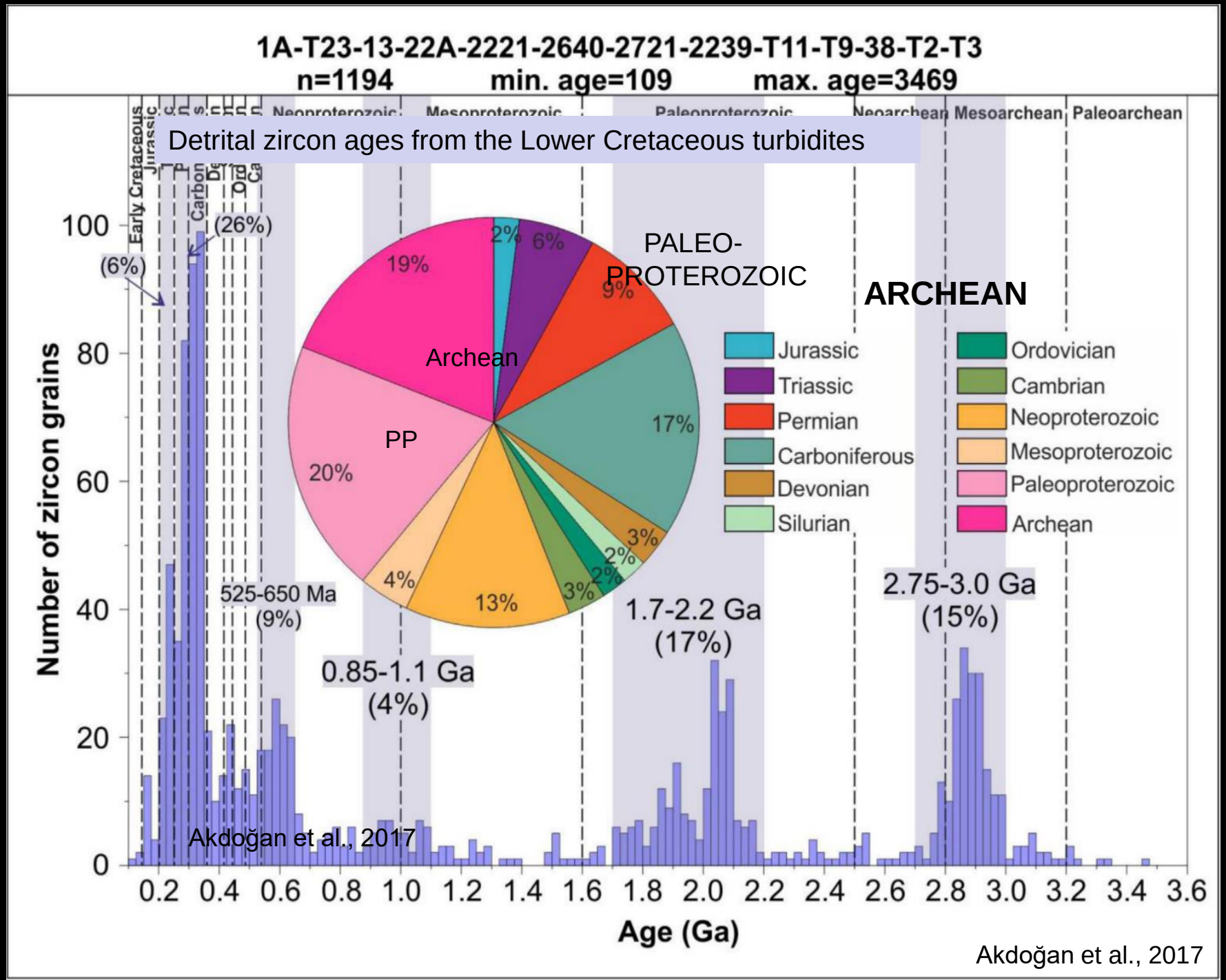

Early Cretaceous
(Barremian -Aptian)
130-110 Ma
Donbas Foldbelt
Karpinsky Swell
EAST EUROPEAN CRATON
Depositional area
of the Çağlayan Group
Scythian P
Dobrugea
Crimea
Mid-Black Sea Ridge
Greater Caucasus
Moesia
Sakarya Zone
Lesser Caucasus
İstanbul Zone
Strandja
Massif
25 km/my
Tethyan ocean
B


Mid-Cretaceous turbidites
Çağlayan Formation
Central Pontides, Kastamonu

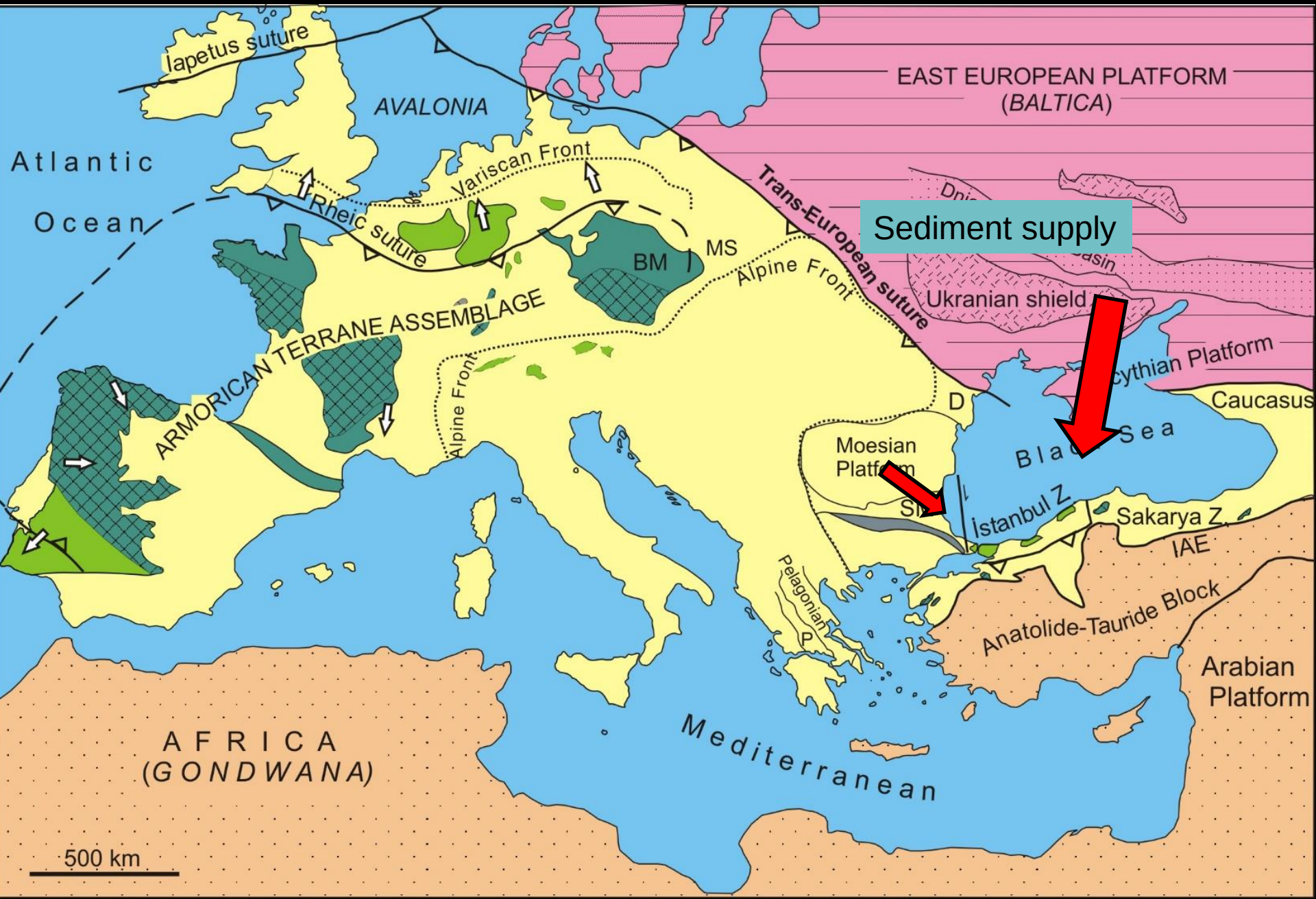
Paleocurrents in the Lower Cretaceous turbidites

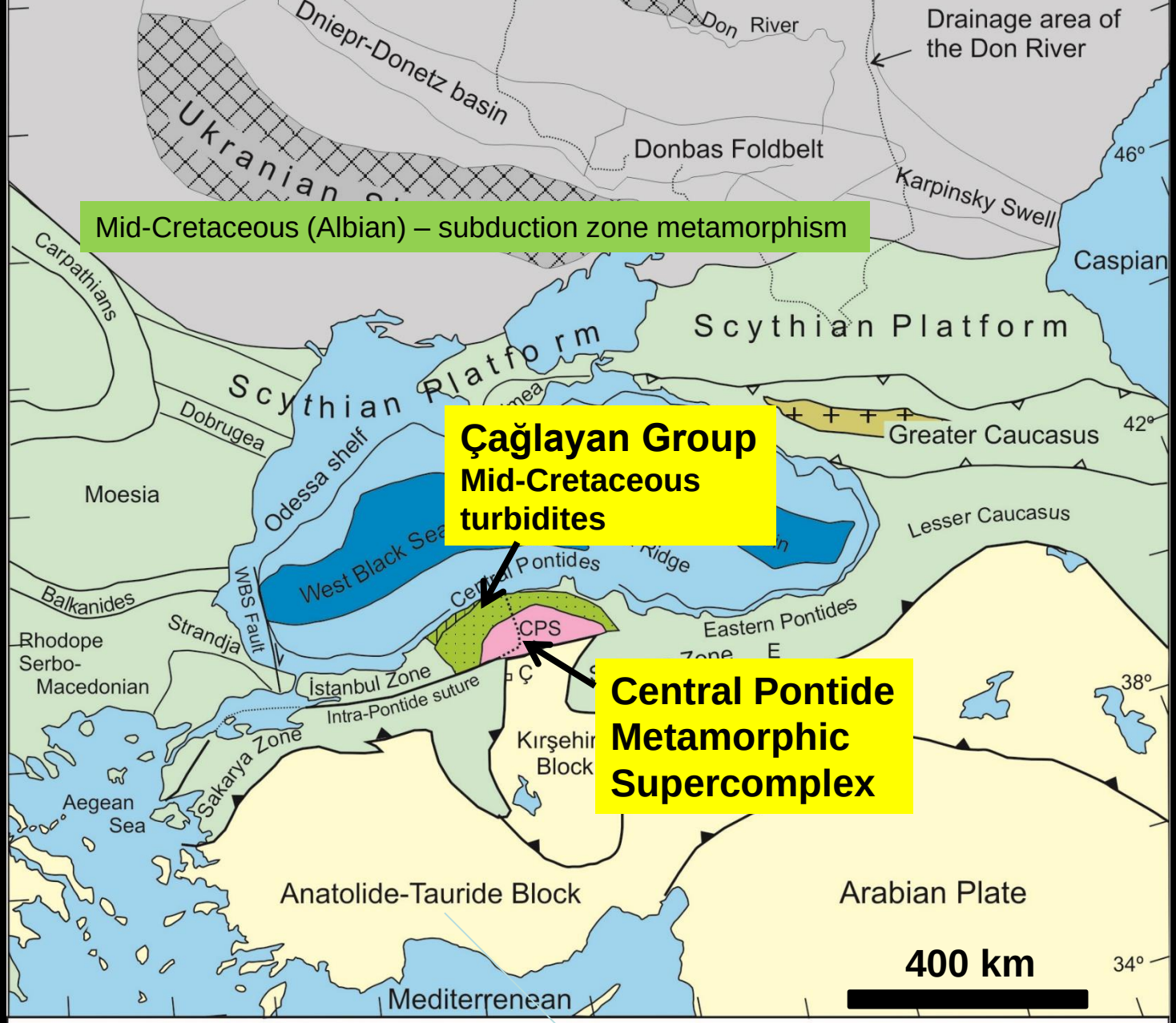


Akdoğan et al., 2017



Akdoğan et al., 2017


Iapetus suture
AVALONIA
EAST EUROPEAN PLATFORM
(BALTICA)
Atlantic
Ocean
Variscan Front
Rheic suture
Trans-European suture
Sediment supply
BM
MS
Alpine Front
Ukranian shield
ARMORICAN TERRANE ASSEMBLAGE
Alpine Front
Scythian Platform
Caucasus
Moesian
Platform
Black Sea
İstanbul Z
Sakarya Z
IAE
Pelagonian
Anatolide-Tauride Block
Arabian
Platform
AFRICA
(GONDWANA)
Mediterranean
500 km


Mid-Cretaceous (Albian) – subduction zone metamorphism
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Caspian
Carpathians
Scythian Platform
Dobrugea
Moesia
Odessa shelf
West Black Sea
Central Pontides
Greater Caucasus
Lesser Caucasus
Eastern Pontides
Balkanides
Strandja
WBS Fault
Rhodope Serbo-Macedonian
İstanbul Zone
Intra-Pontide suture
Sakarya Zone
CPS
Kırşehir Block
Aegean Sea
Anatolide-Tauride Block
Arabian Plate
Mediterranean
46°
42°
38°
34°
400 km
Phanerozoic cover
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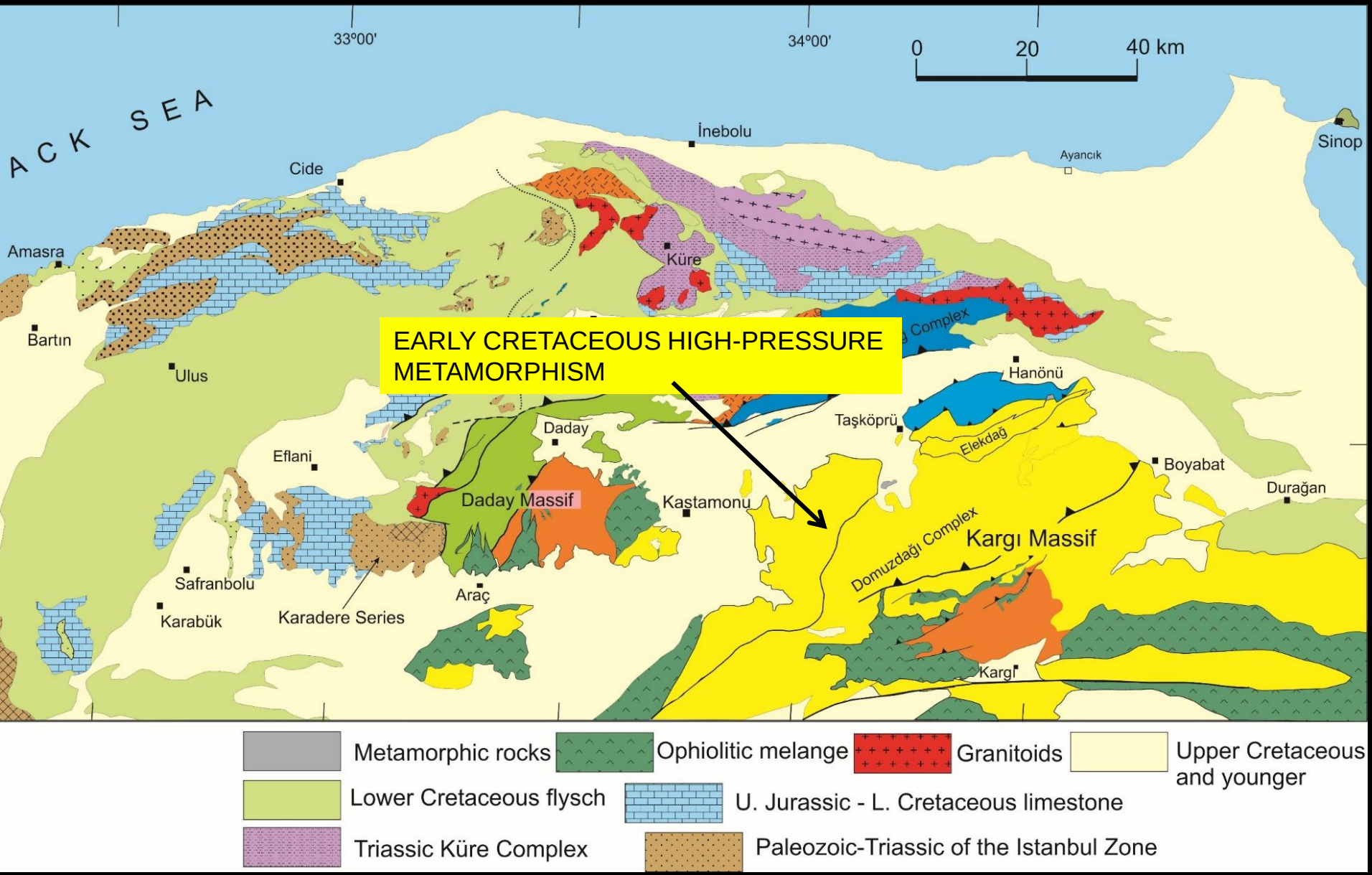
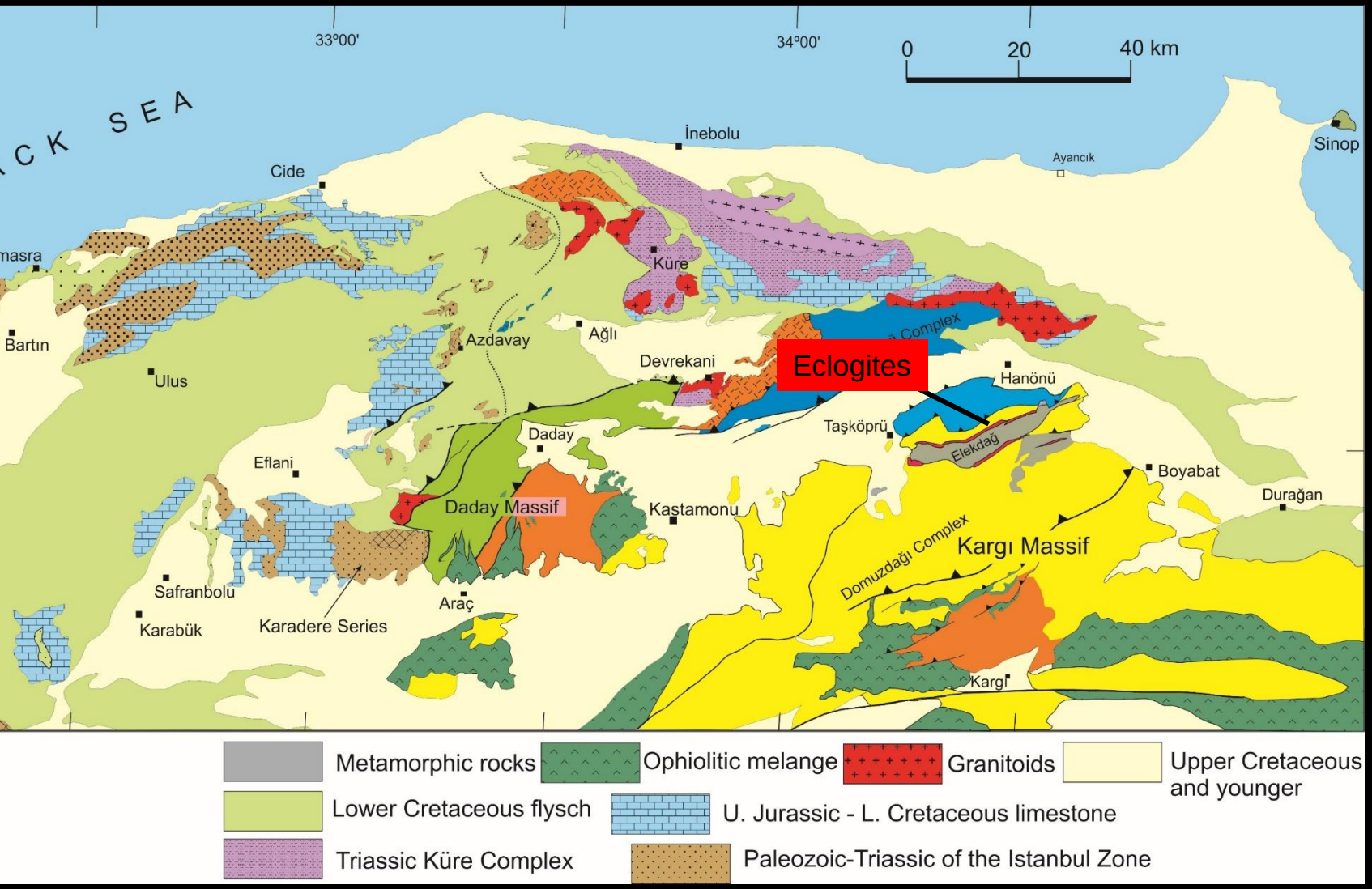
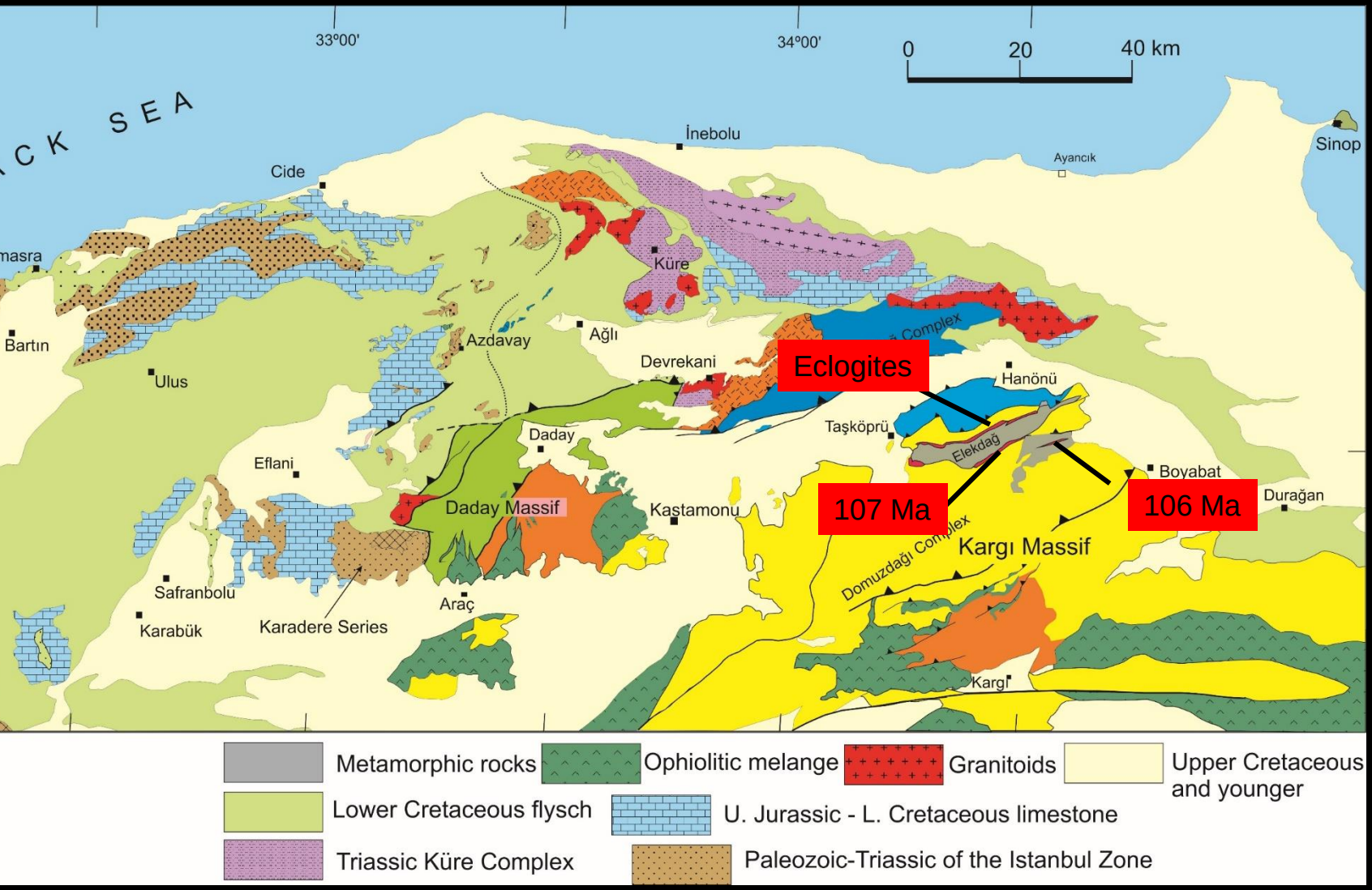
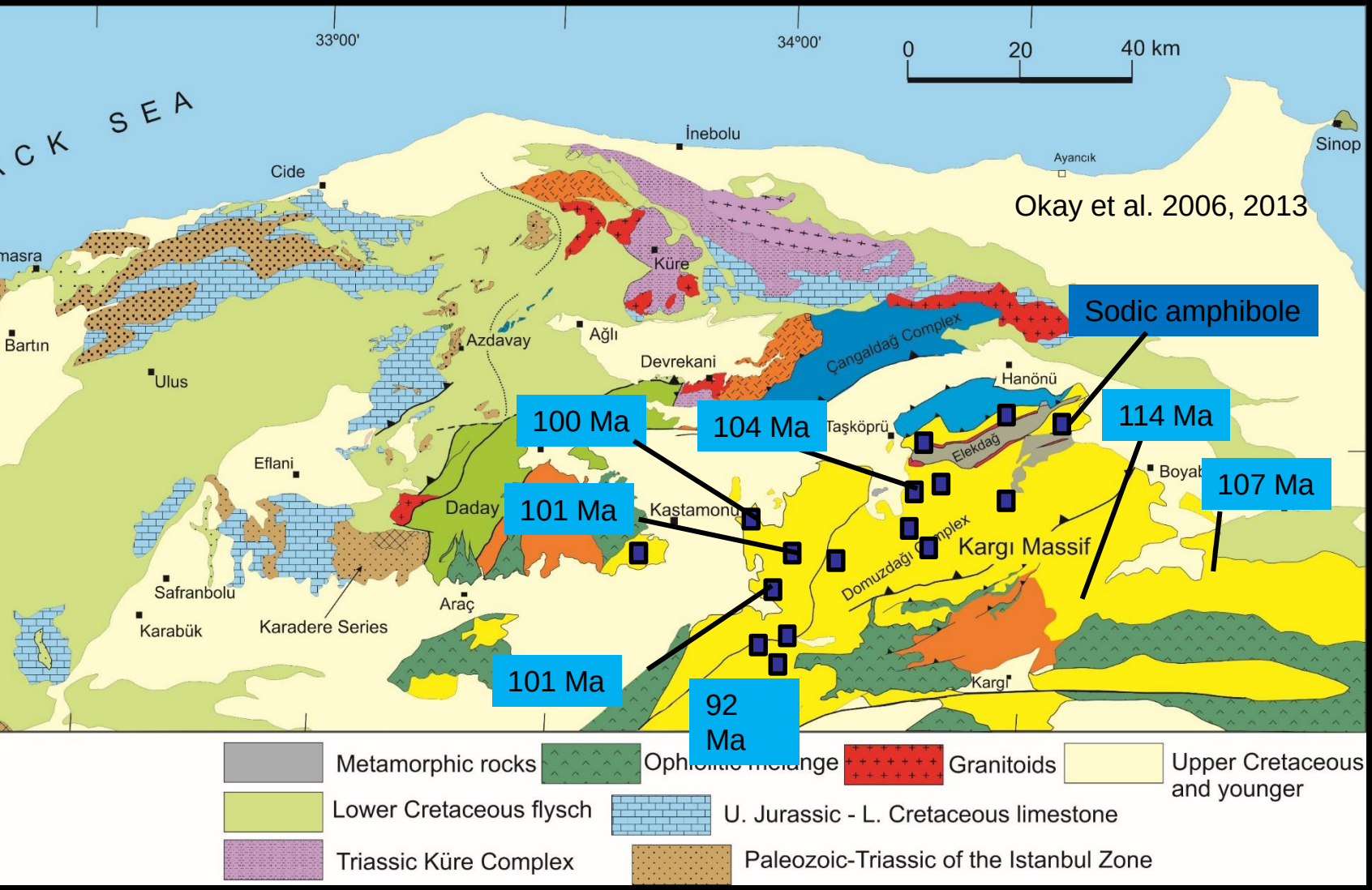
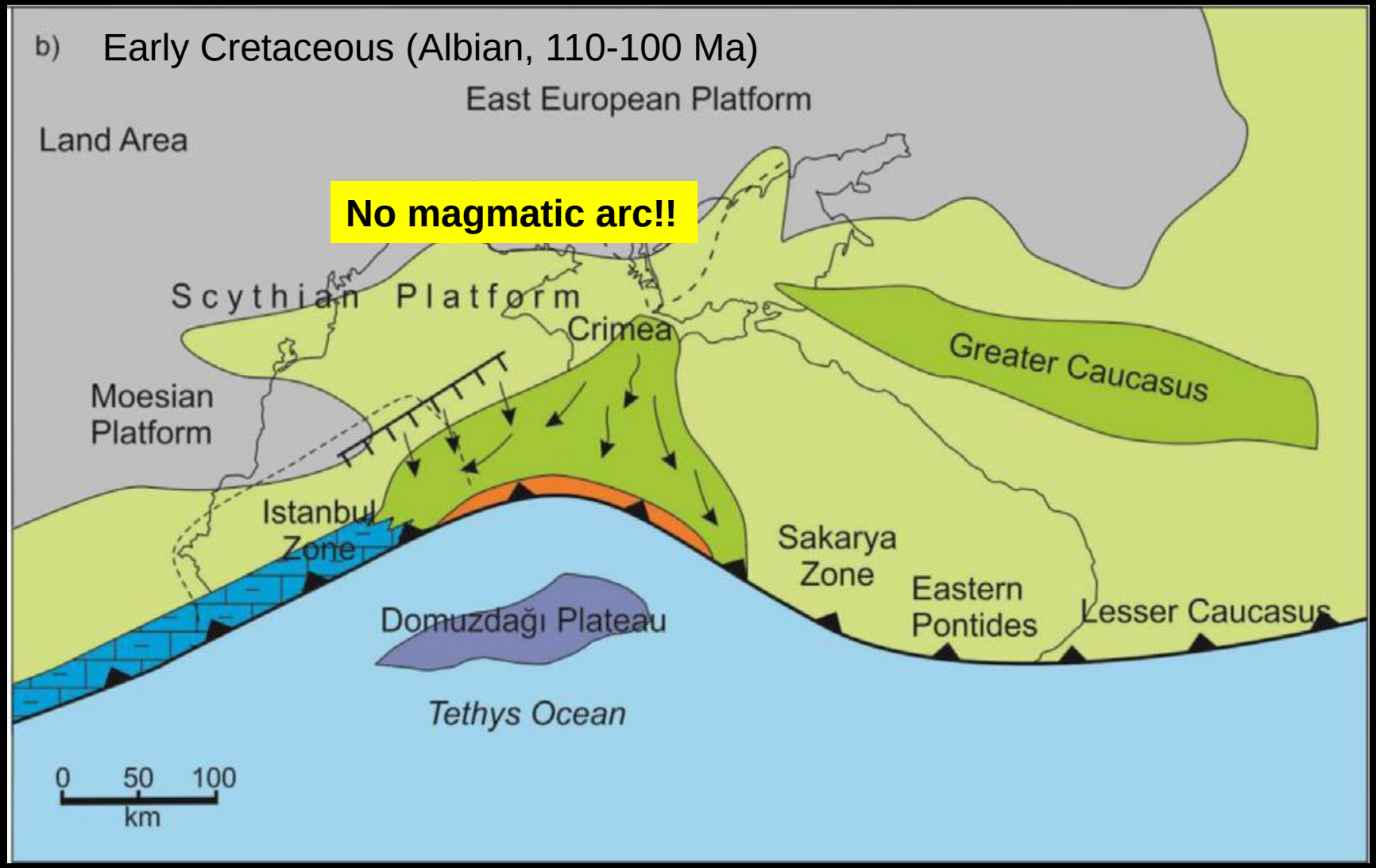

33°00'
34°00'
0
20
40 km
ACK SEA
İnebolu
Sinop
Ayancık
Cide
Amasra
Küre
Bartın
Ulus
EARLY CRETACEOUS HIGH-PRESSURE METAMORPHISM
Hanönü
Taşköprü
Elekdağ
Daday
Eflani
Boyabat
Durağan
Daday Massif
Kastamonu
Domuzdağı Complex
Kargı Massif
Safranbolu
Araç
Karabük
Karadere Series
Kargı
Metamorphic rocks
Ophiolitic melange
Granitoids
Upper Cretaceous and younger
Lower Cretaceous flysch
U. Jurassic - L. Cretaceous limestone
Triassic Küre Complex
Paleozoic-Triassic of the Istanbul Zone

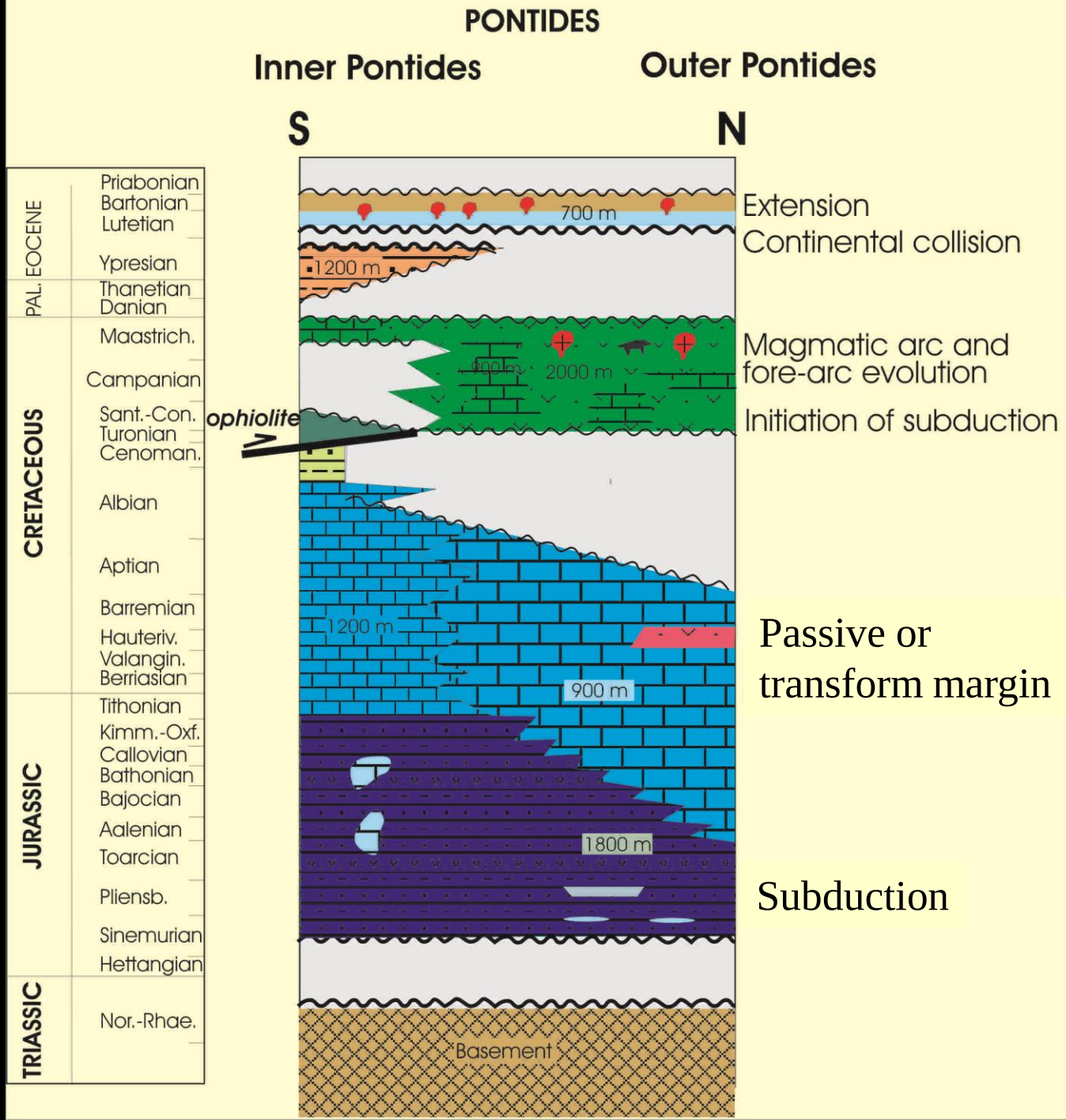

33°00'
34°00'
0
20
40 km
İnebolu
Ayancık
Sinop
Cide
Küre
Bartın
Azdavay
Ağlı
Devrekani
Eclogites
Hanönü
Ulus
Taşköprü
Daday
Elekdağ
Eflani
Boyabat
Durağan
Daday Massif
Kastamonu
Domuzdağı Complex
Kargı Massif
Safranbolu
Araç
Karabük
Karadere Series
Kargı
Metamorphic rocks
Ophiolitic melange
Granitoids
Upper Cretaceous and younger
Lower Cretaceous flysch
U. Jurassic - L. Cretaceous limestone
Triassic Küre Complex
Paleozoic-Triassic of the Istanbul Zone

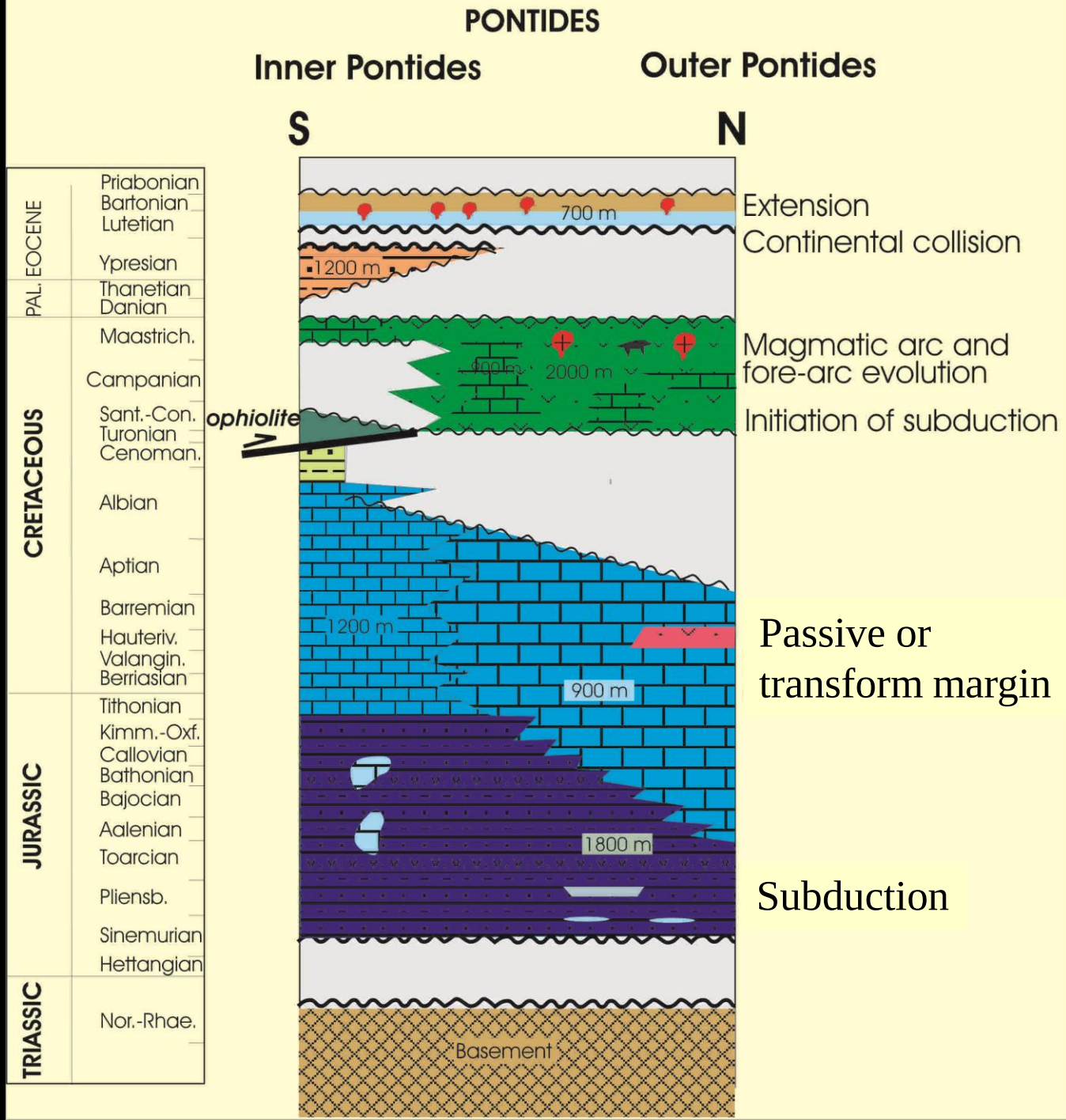

Elekdağ ridge – Early Cretaceous serpentinite and eclogite
Central Pontides, Boyabat region


33°00'
34°00'
0
20
40 km
İnebolu
Ayancık
Sinop
Cide
Küre
Bartın
Ulus
Azdavay
Ağlı
Devrekani
Eclogites
Hanönü
Taşköprü
Elekdağ
Daday
Eflani
Daday Massif
Kastamonu
107 Ma
106 Ma
Boyabat
Durağan
Domuzdağı Complex
Kargı Massif
Safranbolu
Karabük
Karadere Series
Araç
Kargı
Metamorphic rocks
Ophiolitic melange
Granitoids
Upper Cretaceous and younger
Lower Cretaceous flysch
U. Jurassic - L. Cretaceous limestone
Triassic Küre Complex
Paleozoic-Triassic of the Istanbul Zone


33°00'
34°00'
0
20
40 km
İnebolu
Ayancık
Sinop
Cide
Okay et al. 2006, 2013
Küre
Sodic amphibole
Çangaldağ Complex
Azdavay
Ağlı
Bartın
Ulus
Devrekani
Hanönü
100 Ma
104 Ma
Taşköprü
114 Ma
Elekdağ
Eflani
Boyab
107 Ma
Daday
101 Ma
Kastamonu
Domuzdağı Complex
Kargı Massif
Safranbolu
Araç
Karabük
Karadere Series
101 Ma
92 Ma
Kargı
Metamorphic rocks
Granitoids
Upper Cretaceous and younger
Lower Cretaceous flysch
U. Jurassic - L. Cretaceous limestone
Triassic Küre Complex
Paleozoic-Triassic of the Istanbul Zone


b) Early Cretaceous (Albian, 110-100 Ma)
East European Platform
Land Area
No magmatic arc!!
Scythian Platform
Crimea
Greater Caucasus
Moesian Platform
Istanbul Zone
Sakarya Zone
Eastern Pontides
Lesser Caucasus
Domuzdağı Plateau
Tethys Ocean
0 50 100
km


PONTIDES
Inner Pontides
Outer Pontides
S
N
PAL. EOCENE
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Danian
CRETACEOUS
Maastrich.
Campanian
Sant.-Con.
Turonian
Cenoman.
Albian
Aptian
Barremian
Hauteriv.
Valangin.
Berriasian
JURASSIC
Tithonian
Kimm.-Oxf.
Callovian
Bathonian
Bajocian
Aalenian
Toarcian
Pliensb.
Sinemurian
Hettangian
TRIASSIC
Nor.-Rhae.
ophiolite
700 m
1200 m
900 m
2000 m
1200 m
900 m
1800 m
Basement
Extension
Continental collision
Magmatic arc and
fore-arc evolution
Initiation of subduction
Passive or
transform margin
Subduction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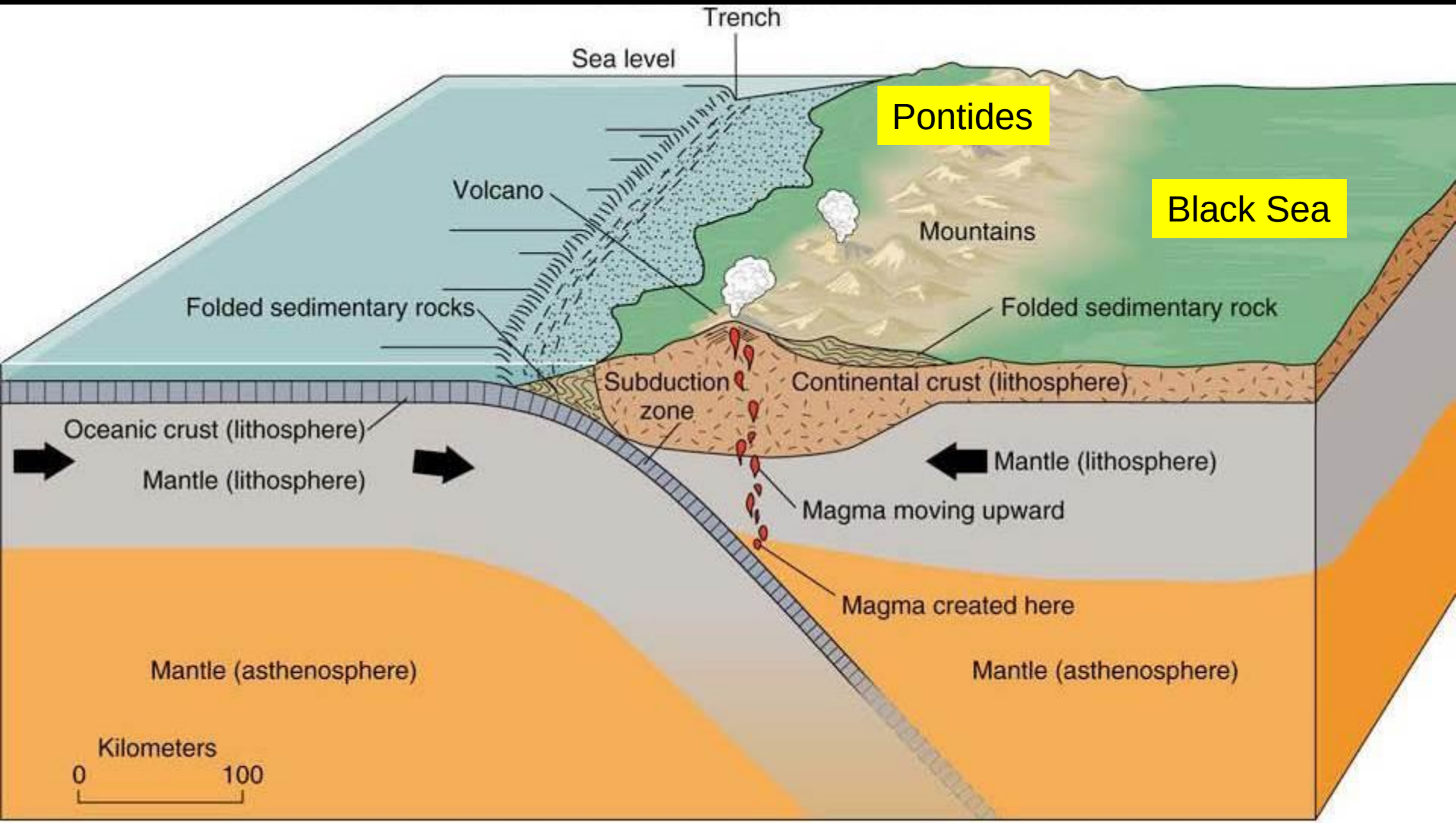
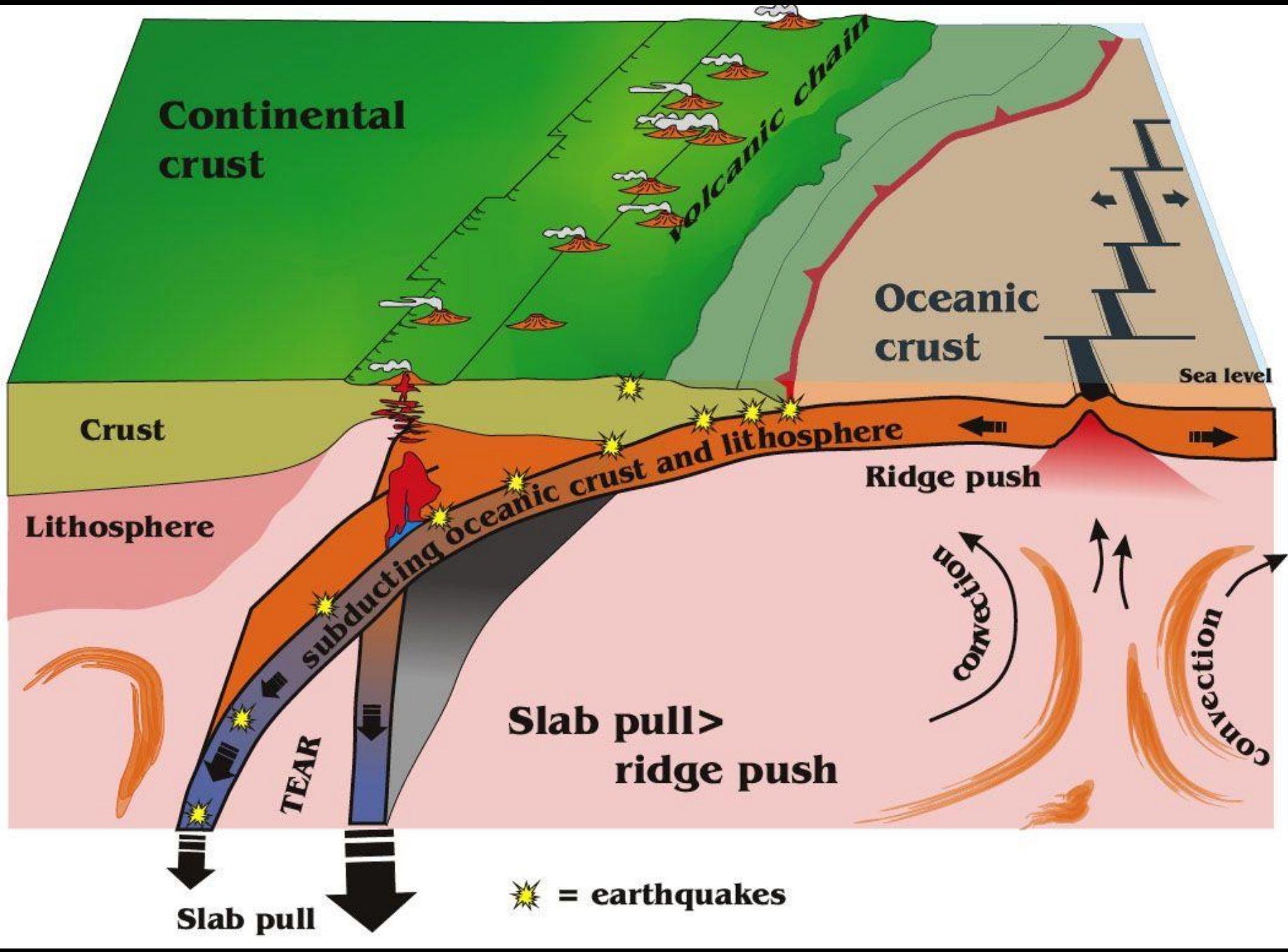
1800 m
Basement
Extension
Continental collision
Magmatic arc and
fore-arc evolution
Initiation of subduction
Passive or
transform margin
Subduction

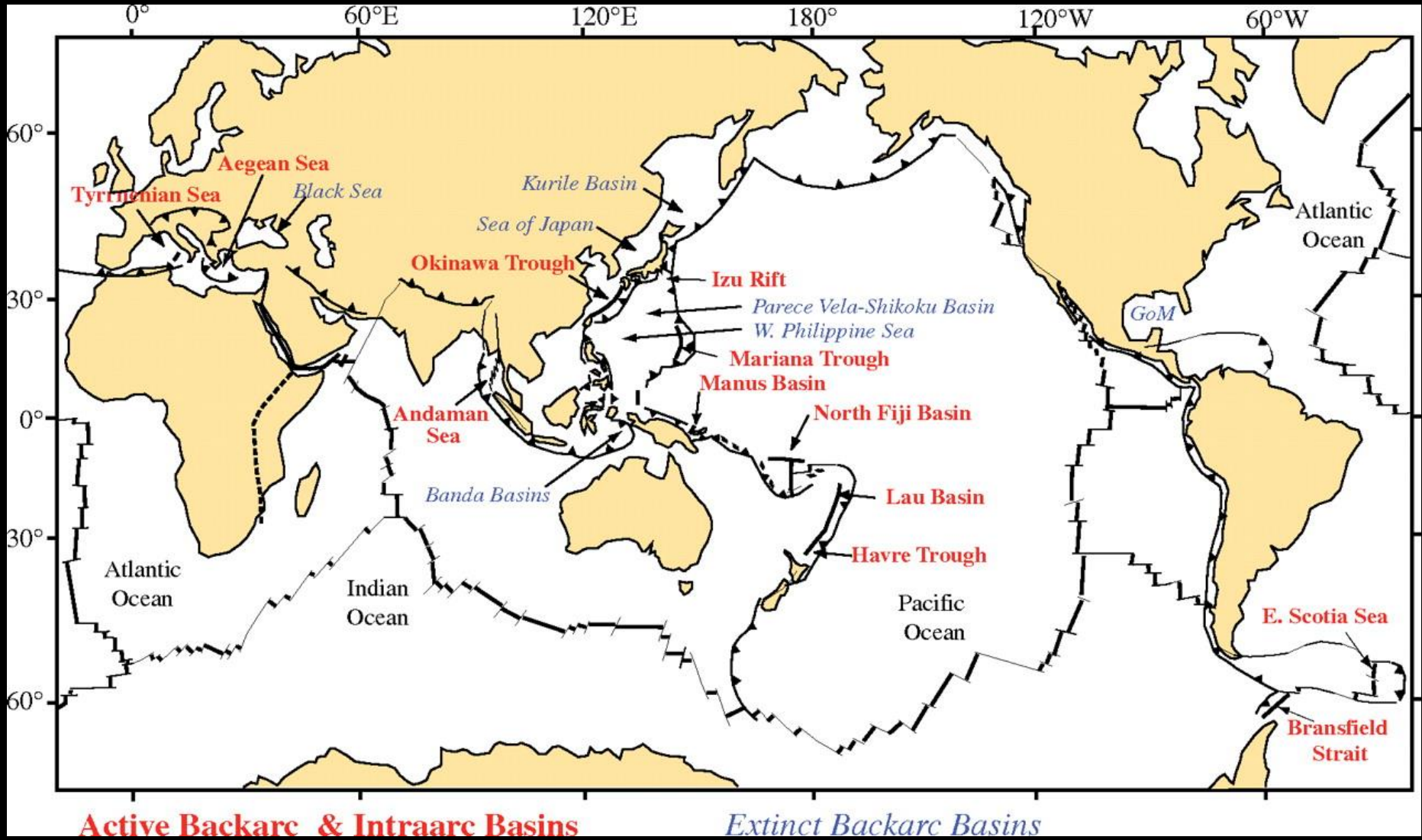
LATE CRETACEUS IN THE PONTIDES –

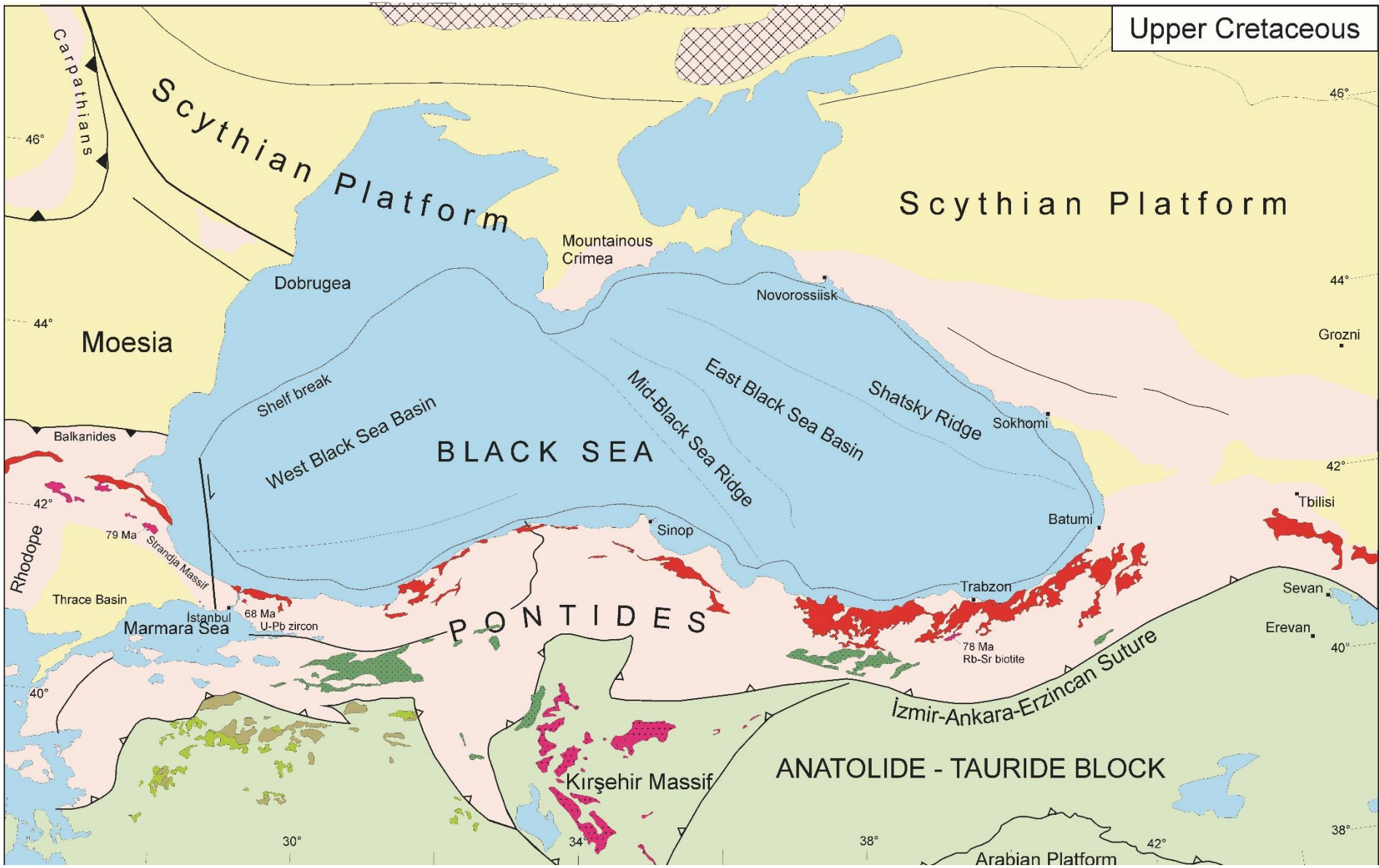
DEVELOPMENT OF THE MAGMATIC ARC AND OPENING OF THE BLACK SEA AS A BACK-ARC BASIN



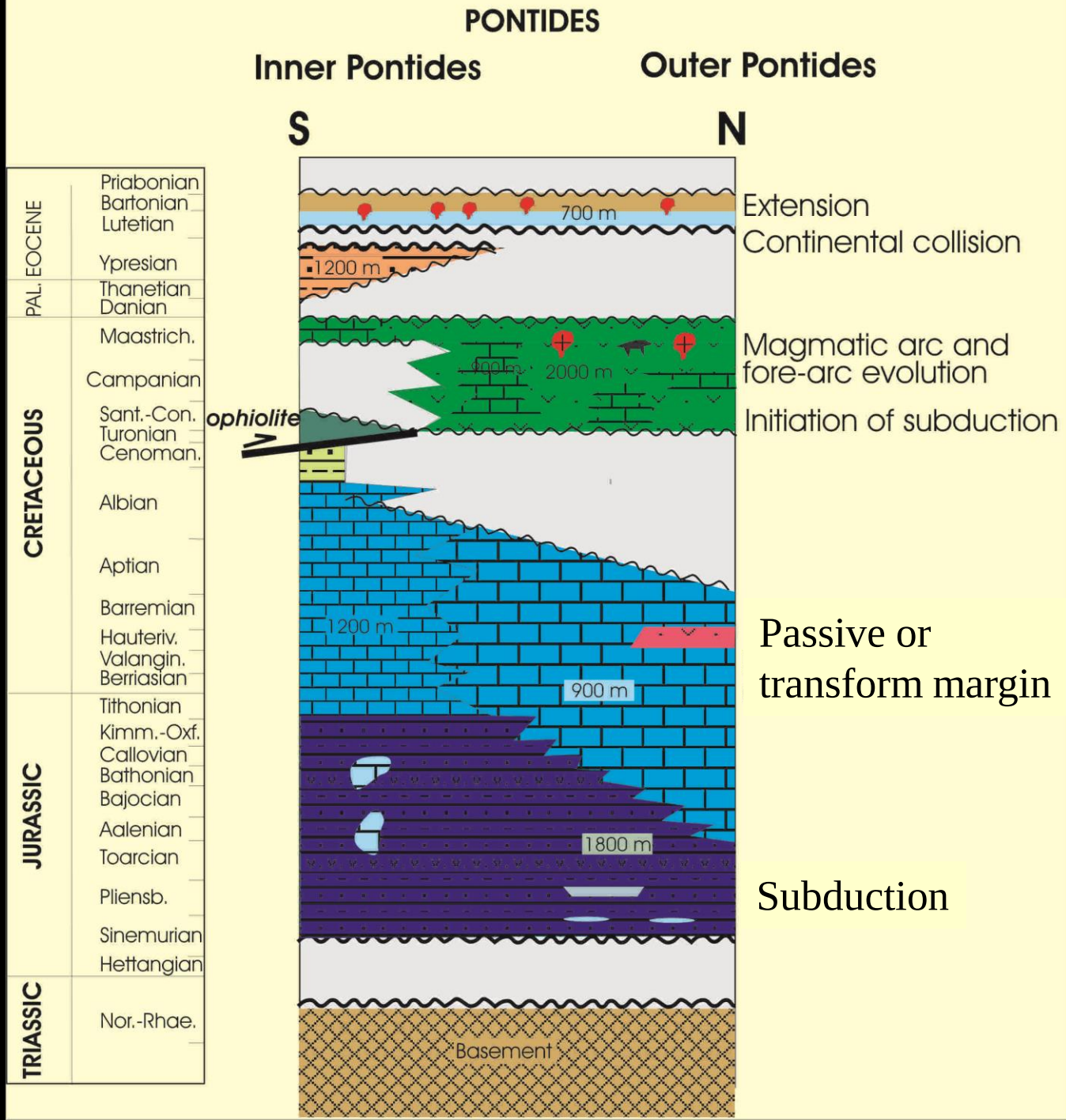
Convergent Margins and Magma Genesis

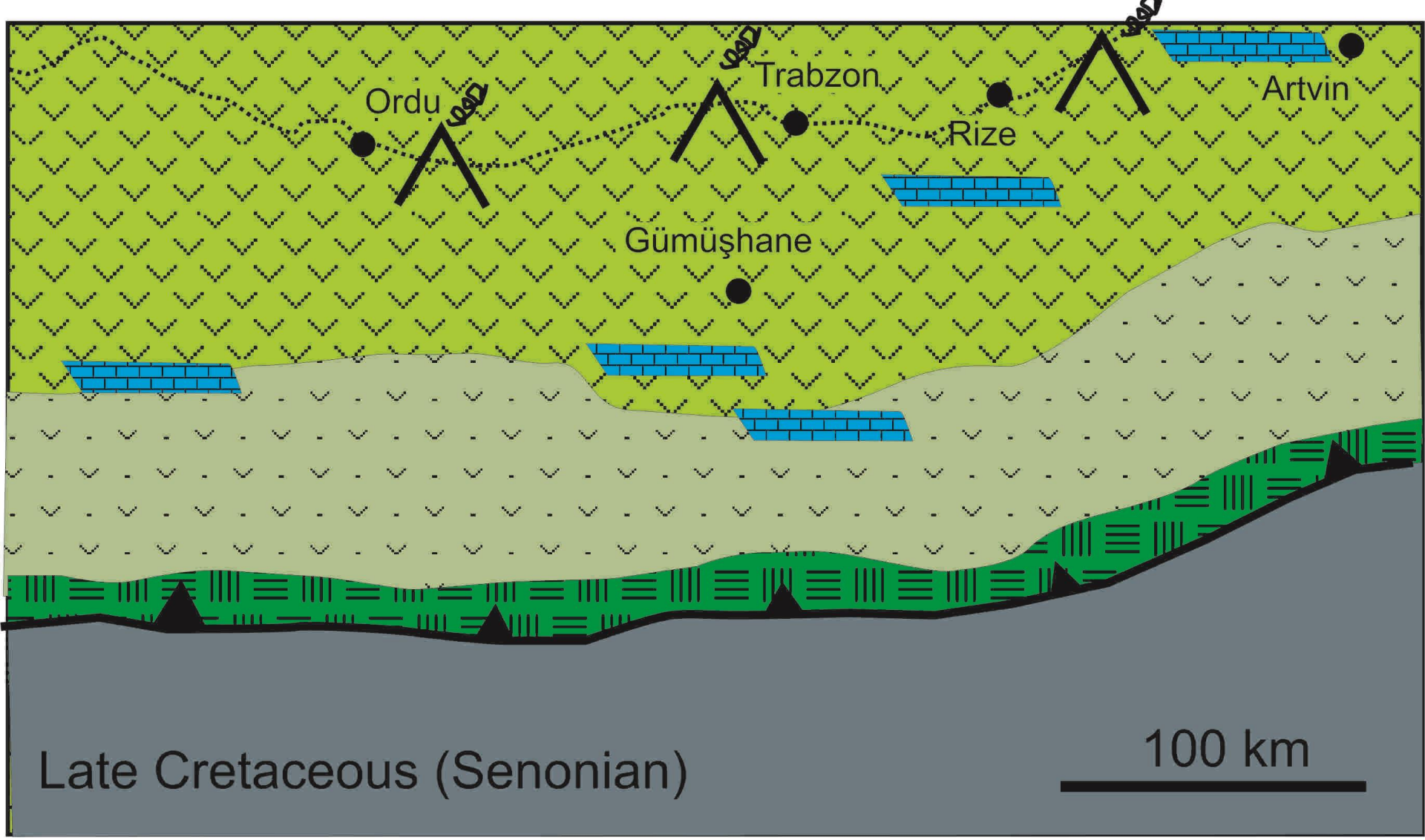

Continental crust
volcanic chain
Oceanic crust
Sea level
Crust
Lithosphere
subducting oceanic crust and lithosphere
Ridge push
convection
convection
Slab pull>
ridge push
TEAR
Slab pull
= earthquakes

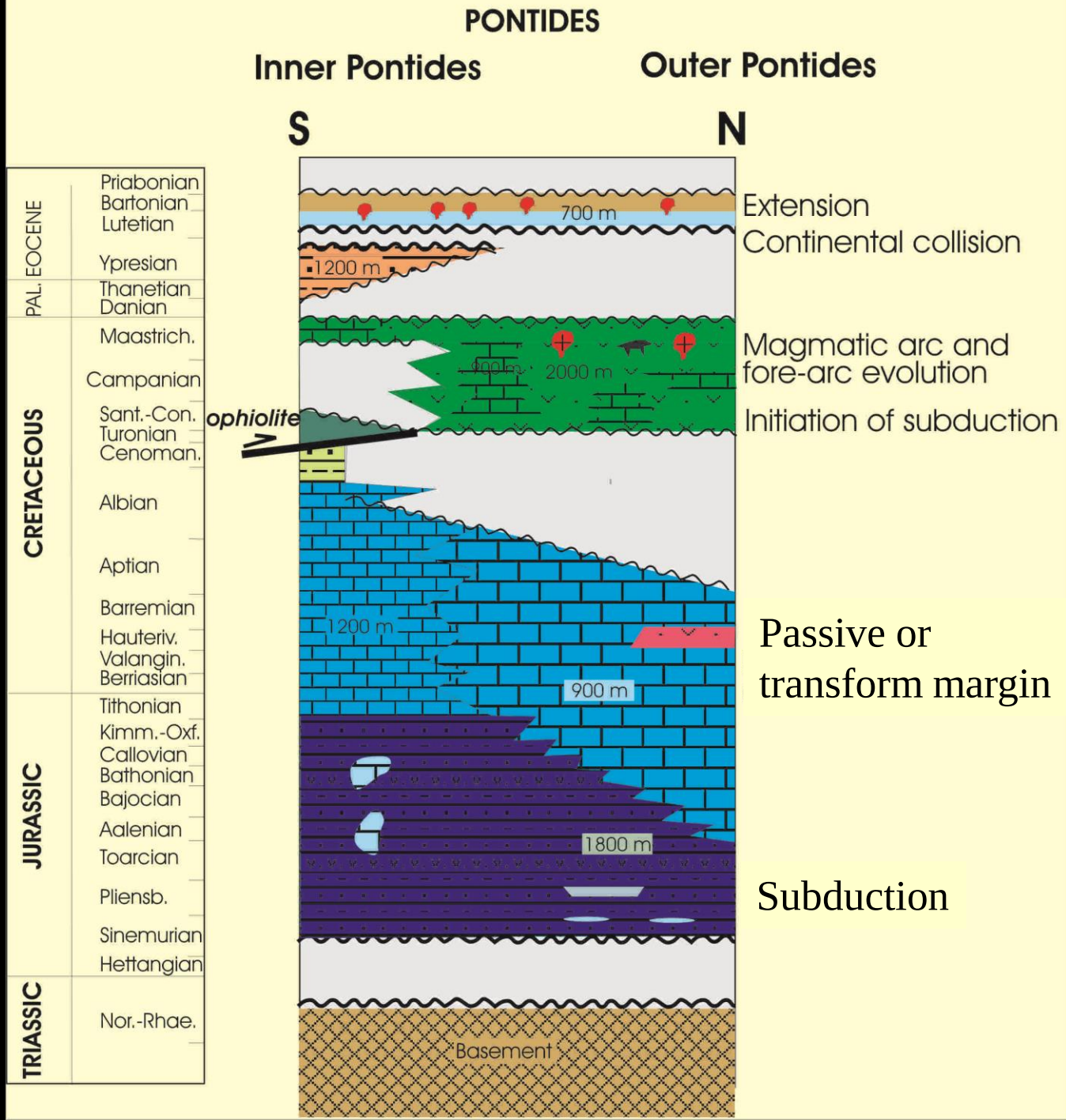

0°
60°E
120°E
180°
120°W
60°W
60°
30°
0°
30°
60°
Aegean Sea
Tyrrhenian Sea
Black Sea
Kurile Basin
Sea of Japan
Okinawa Trough
Izu Rift
Parece Vela-Shikoku Basin
W. Philippine Sea
Mariana Trough
Manus Basin
North Fiji Basin
Lau Basin
Havre Trough
Andaman Sea
Banda Basins
Atlantic Ocean
Indian Ocean
Pacific Ocean
Atlantic Ocean
GoM
E. Scotia Sea
Bransfield Strait
Active Backarc & Intraarc Basins
Extinct Backarc Basins


Upper Cretaceous
Carpathians
Scythian Platform
Scythian Platform
Mountainous Crimea
Dobrugea
Novorossiisk
Moesia
Grozni
Shelf break
West Black Sea Basin
BLACK SEA
Mid-Black Sea Ridge
East Black Sea Basin
Shatsky Ridge
Sokhomi
Balkanides
Tbilisi
Batumi
Sinop
79 Ma
Strandja Massif
Rhodope
Thrace Basin
İstanbul
Marmara Sea
68 Ma
U-Pb zircon
PONTIDES
Trabzon
Sevan
Erevan
78 Ma
Rb-Sr biotite
İzmir-Ankara-Erzincan Suture
Kirşehir Massif
ANATOLIDE - TAURIDE BLOCK
Arabian Platform
46°
44°
42°
40°
38°
30°
34°
38°
42°


koprufotograflari.com


PONTIDES
Inner Pontides
Outer Pontides
S
N
PAL. EOCENE
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Danian
CRETACEOUS
Maastrich.
Campanian
Sant.-Con.
Turonian
Cenoman.
Albian
Aptian
Barremian
Hauteriv.
Valangin.
Berriasian
JURASSIC
Tithonian
Kimm.-Oxf.
Callovian
Bathonian
Bajocian
Aalenian
Toarcian
Pliensb.
Sinemurian
Hettangian
TRIASSIC
Nor.-Rhae.
ophiolite
700 m
1200 m
900 m
2000 m
1200 m
900 m
1800 m
Basement
Extension
Continental collision
Magmatic arc and
fore-arc evolution
Initiation of subduction
Passive or
transform margin
Subduction


Ordu
Trabzon
Rize
Artvin
Gümüşhane
Late Cretaceous (Senonian)
100 km
Dacitic, rhyolitic, andesitic, basaltic lava, agglomerate, tuff
Volcanoclastic sandstone, basaltic, andesitic agglomerate, tuff
Pelagic limestone
Accretionary complex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Inner Pontides
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Priabonian
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Toarcian
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TRIASSIC
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ophiolite
700 m
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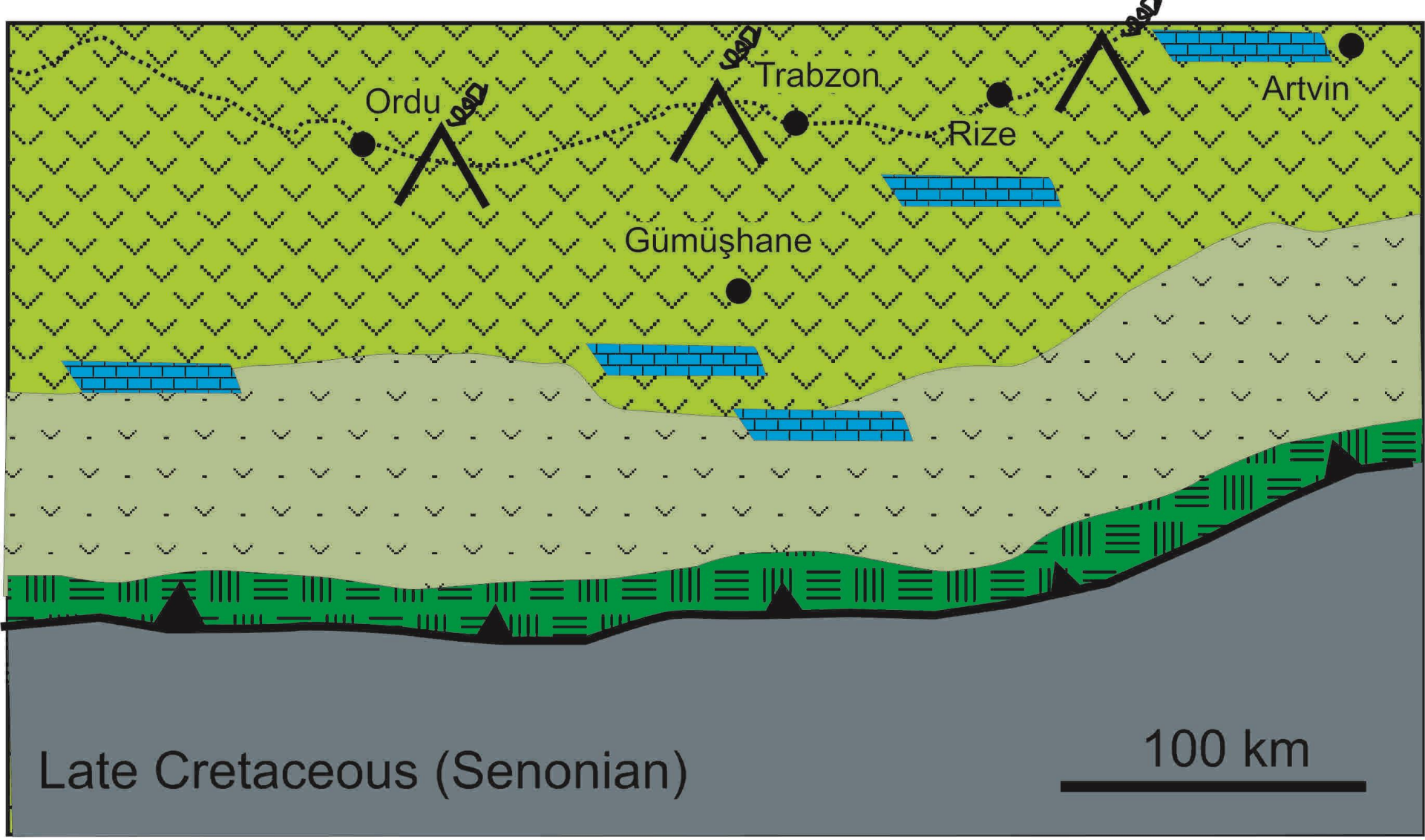
Ordu
Trabzon
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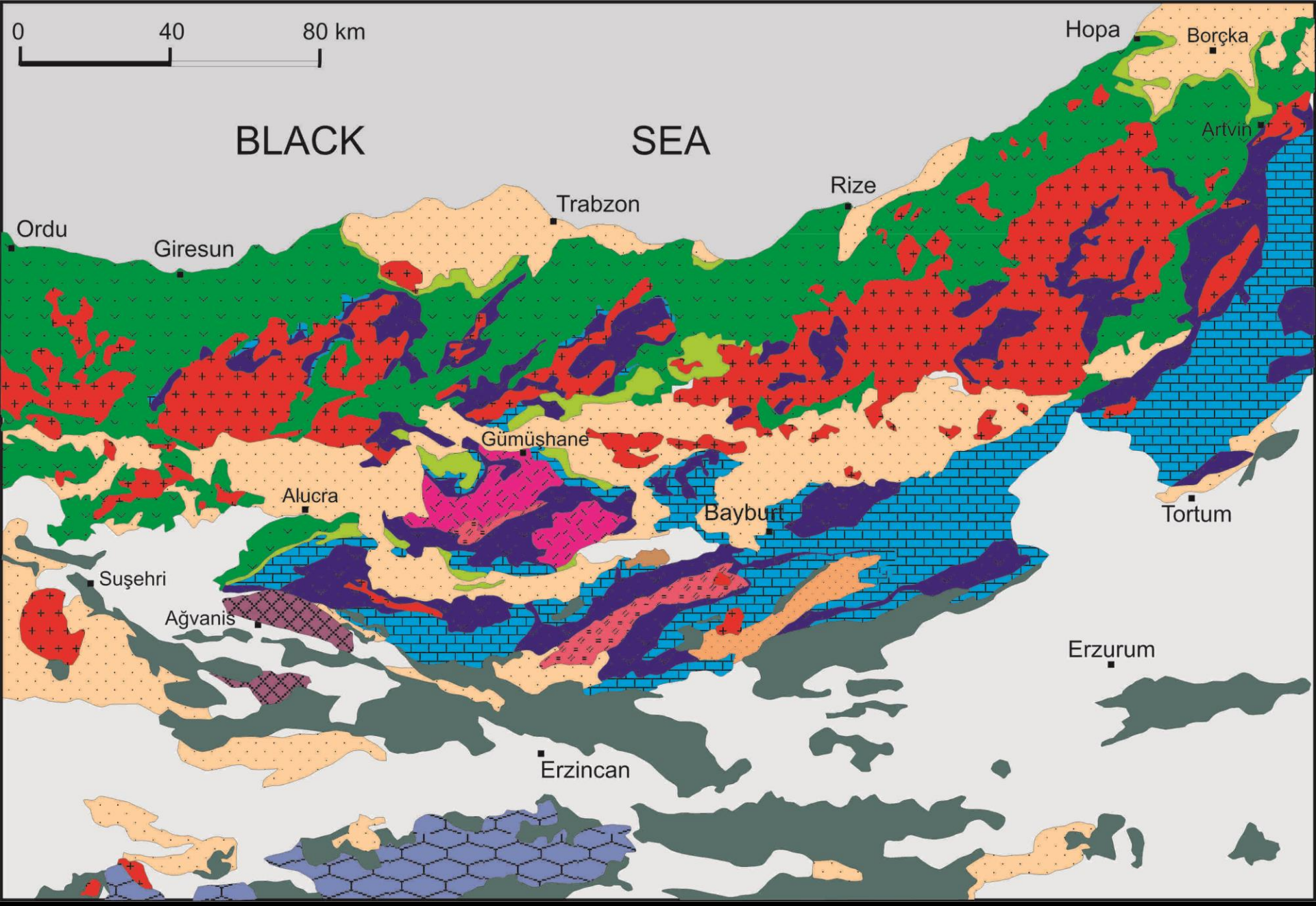
Artvin
Gümüşhane
Late Cretaceous (Senonian)
100 km
Dacitic, rhyolitic, andesitic, basaltic lava, agglomerate, tuff
Volcanoclastic sandstone, basaltic, andesitic agglomerate, tuff
Pelagic limestone
Accretionary complex

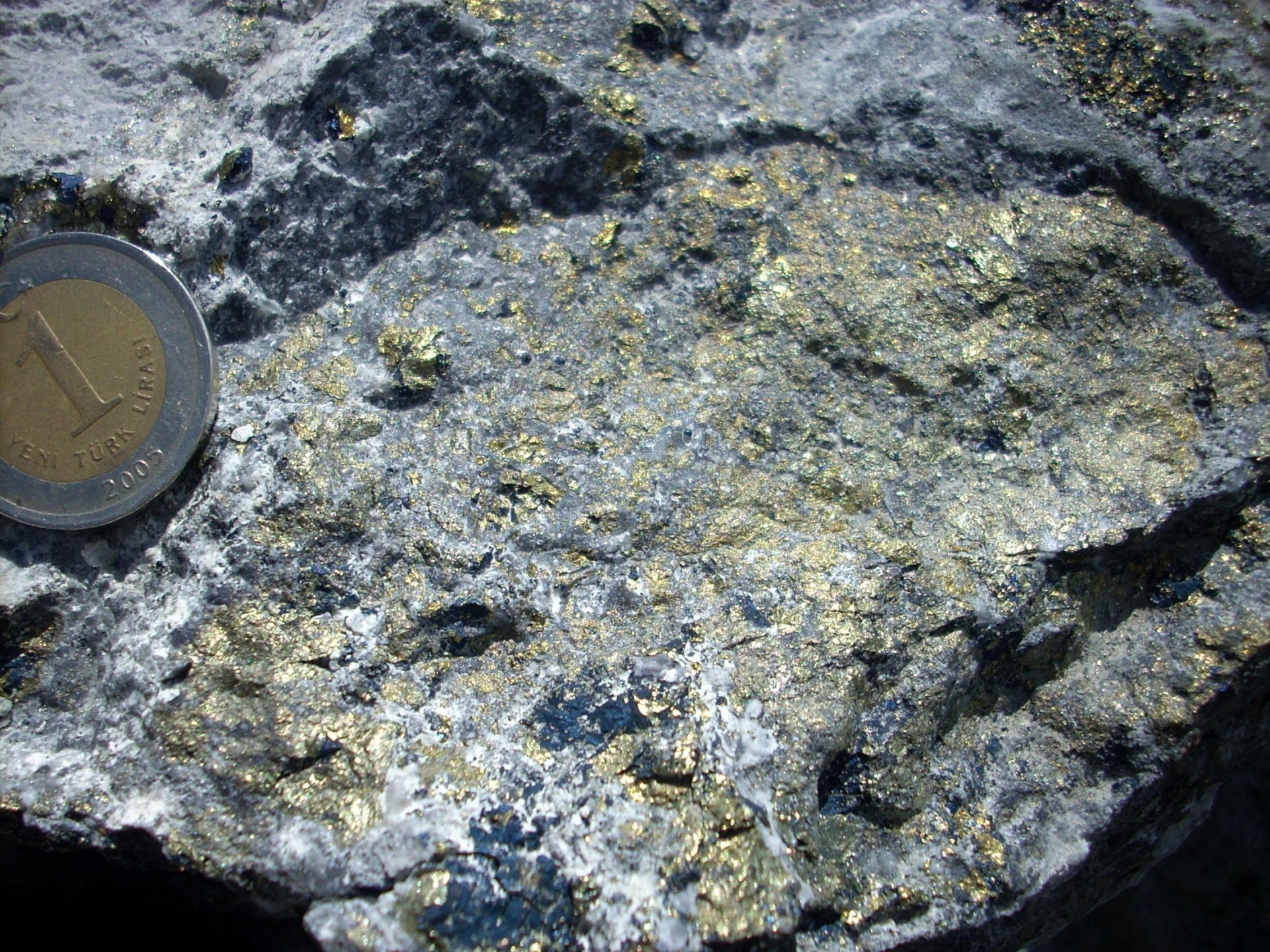
KURUKO TYPE VOLCANIC MASSIVE SULPHIDE DEPOSITS

MURGUL, ÇAYELİ etc.


0
40
80 km
BLACK
SEA
Hopa
Borçka
Artvin
Rize
Trabzon
Ordu
Giresun
Gümüşhane
Alucra
Bayburt
Tortum
Suşehri
Ağvanis
Erzurum
Erzincan

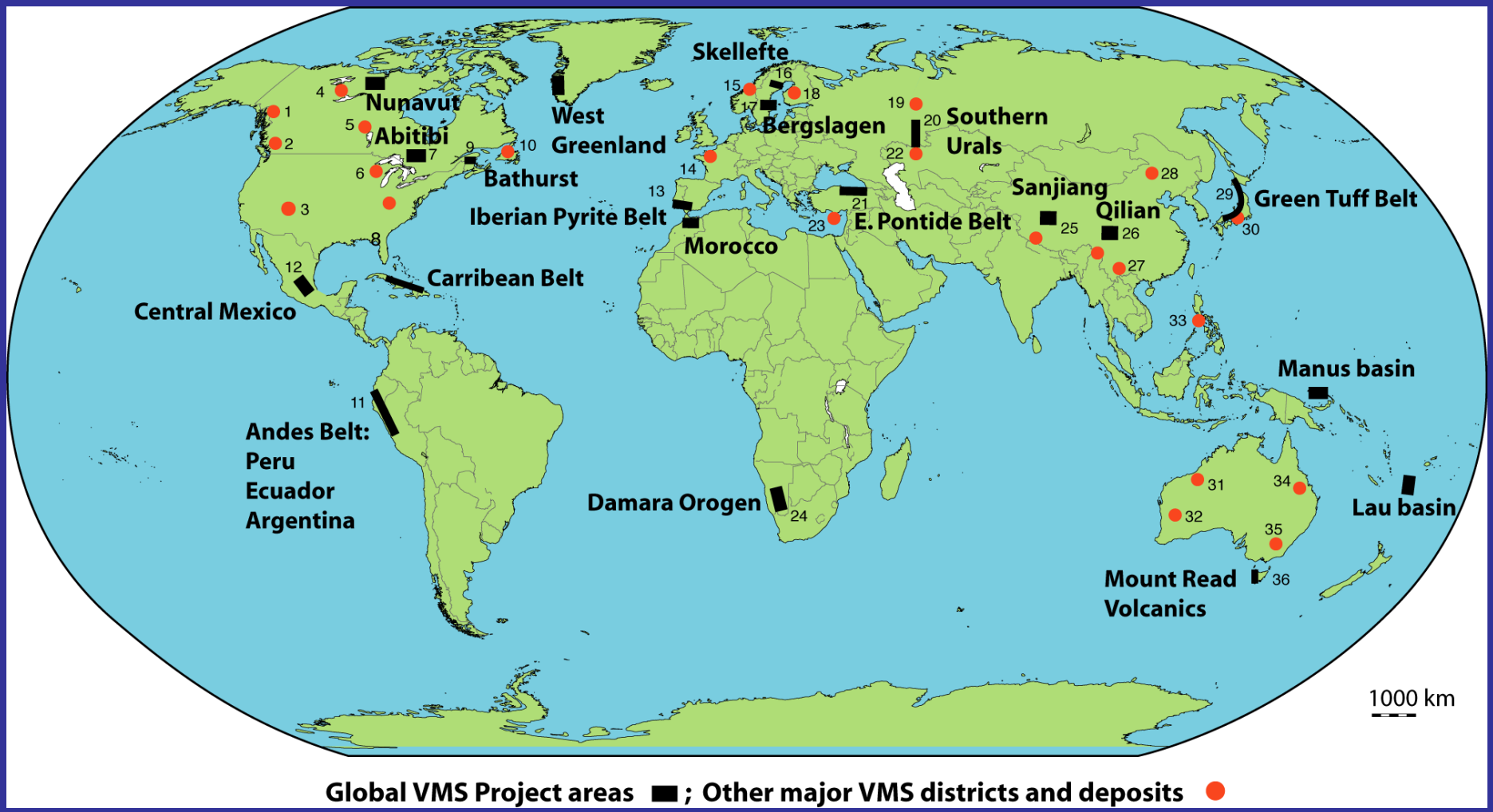

LAHANOS
G25
1980
normet

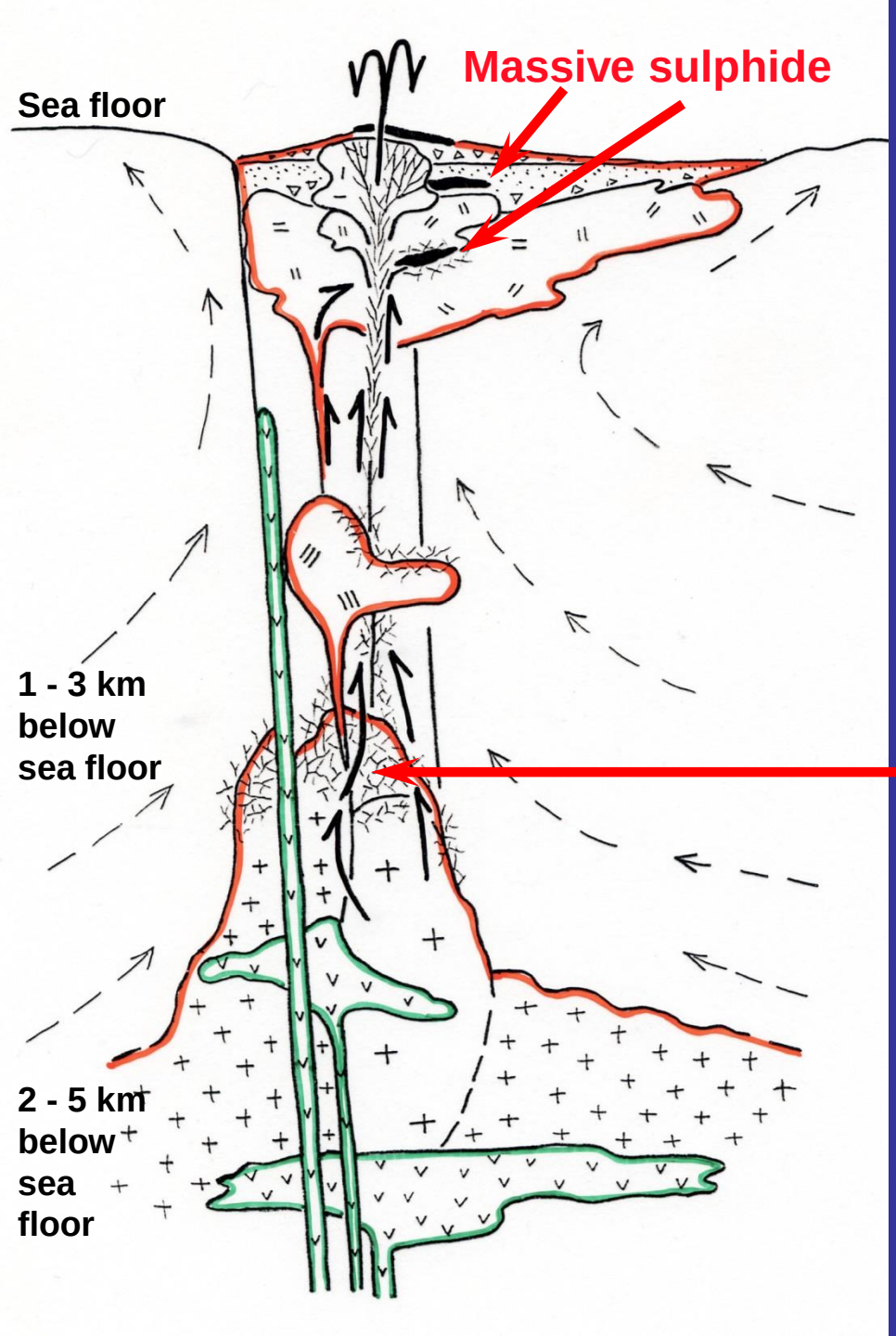
ÇAYELİ


1
YENİ TÜRK LİRASI
2005

MURGUL

Global Comparison of VMS Districts: Project Study Areas





Model for rhyolite-hosted massive sulphide ores

Submarine rhyolite volcano

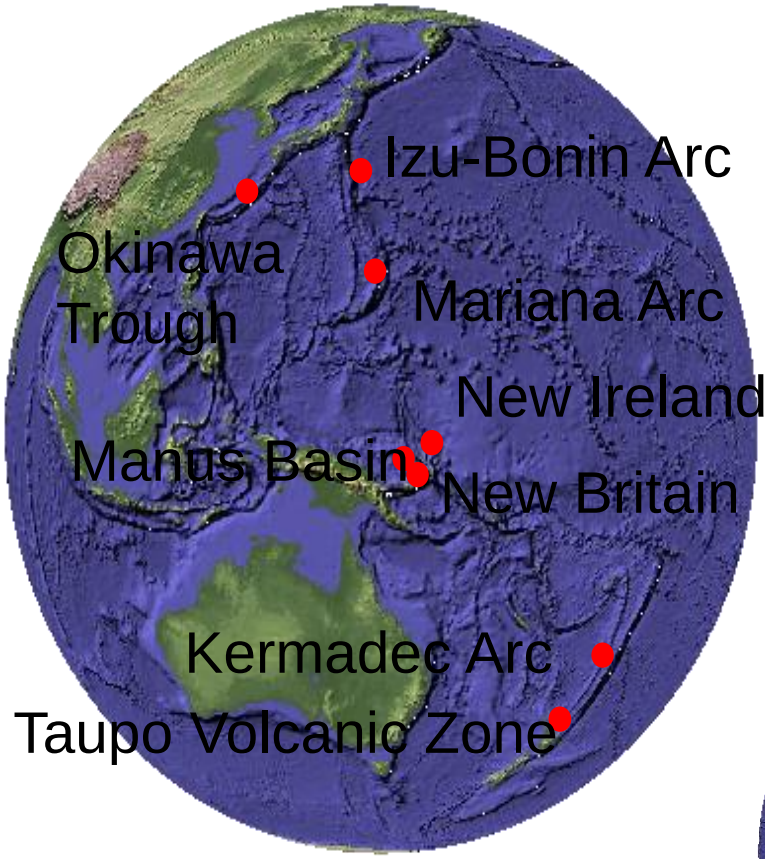
Regional convective sea water hydrothermal system (carries metals, causes alteration)

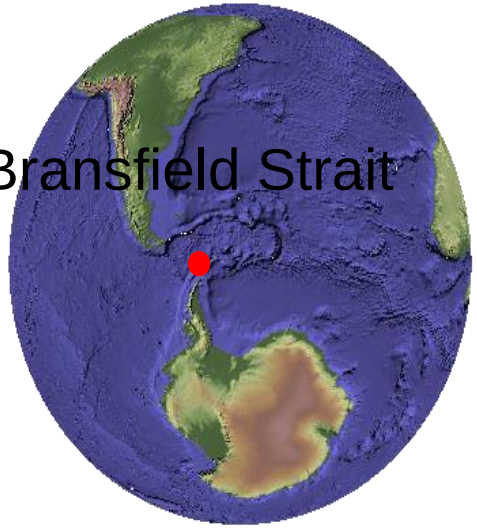
Magmatic hydrothermal system (carries metals, causes alteration

Felsic subvolcanic intrusion

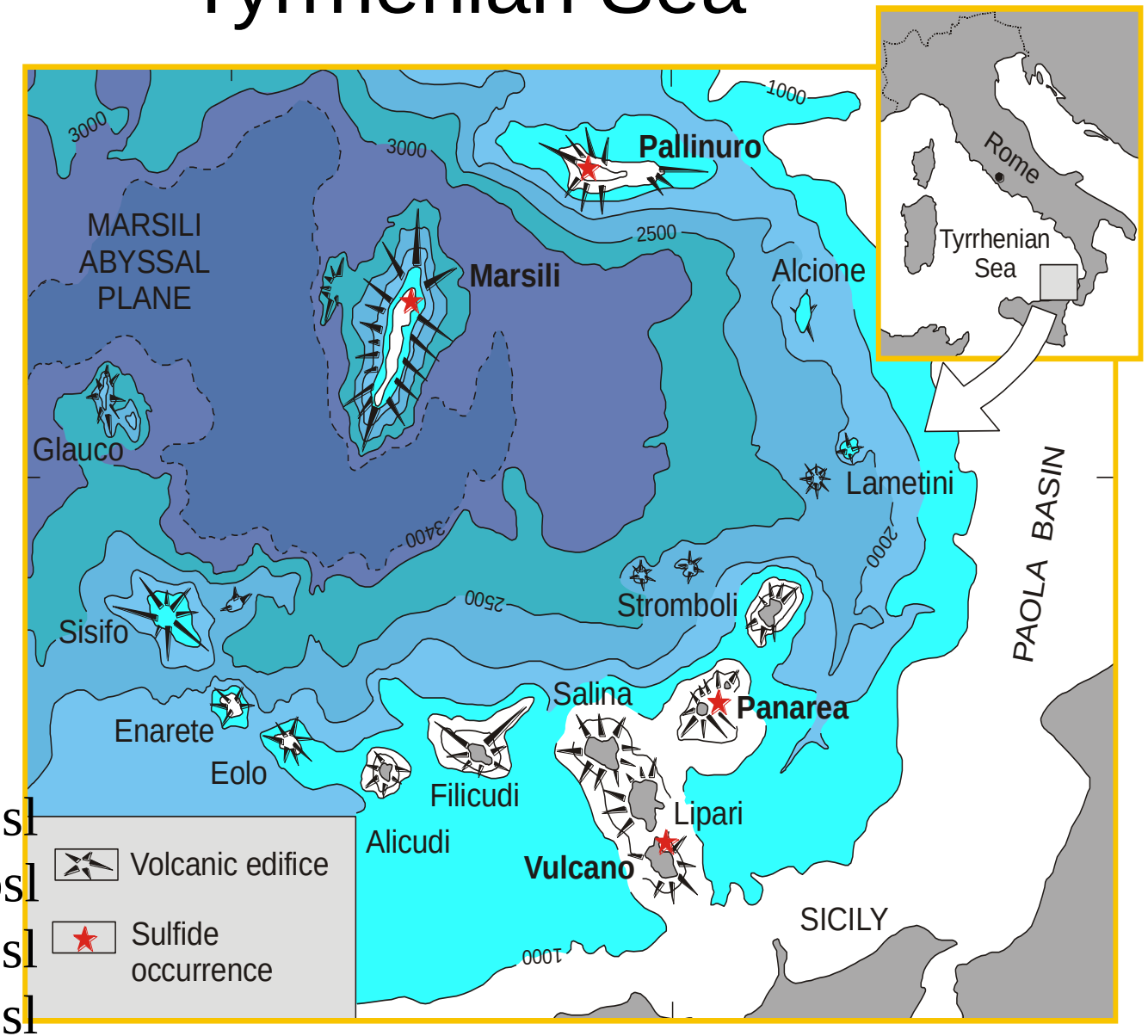
Mafic intrusions

Modern shallow marine systems



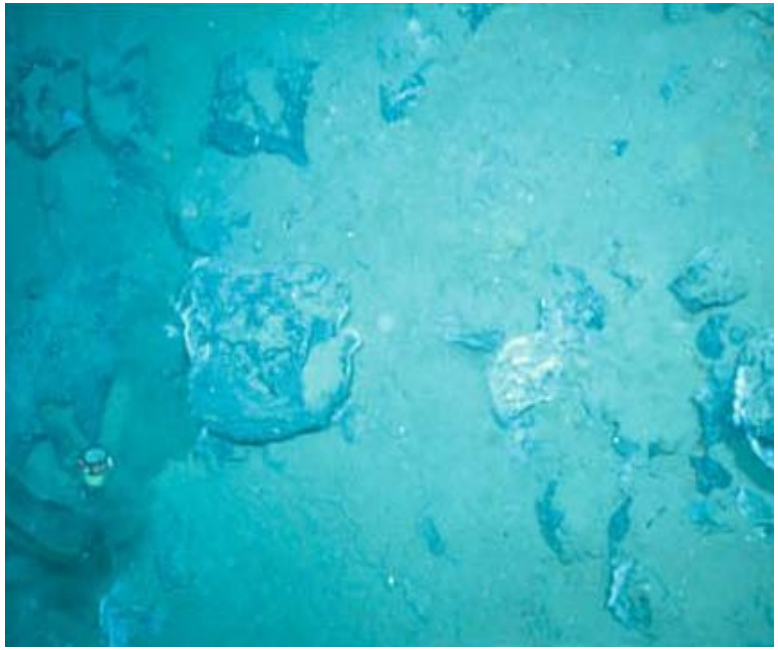


Tyrrhenian Sea

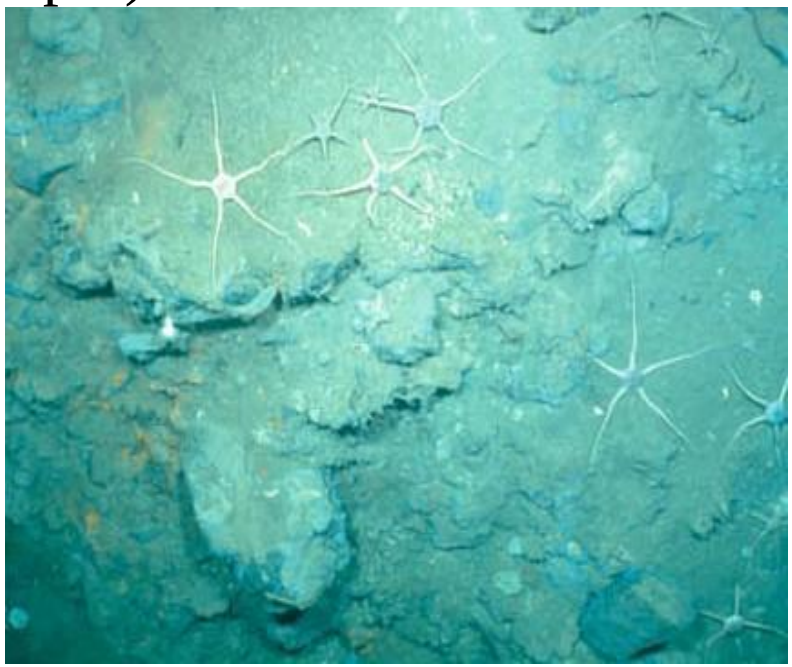


Vulcano: <15 mbsl
Panarea: 80 mbsl
Marsili: 500 mbsl
Palinuro: 600 mbsl

Beccaluva et al. (1985)



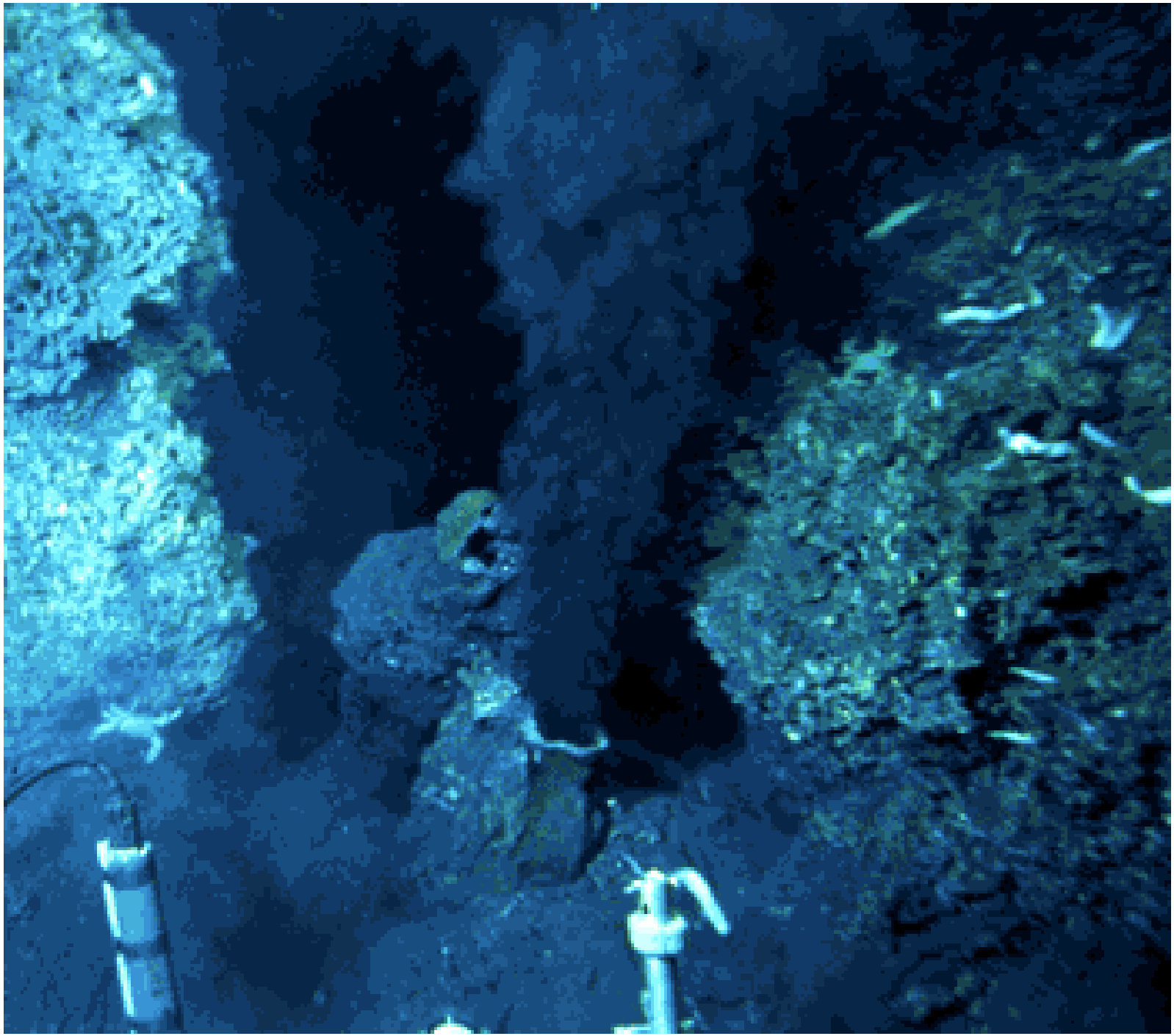
Sulfide talus at Hook Ridge (1070 m water depth)

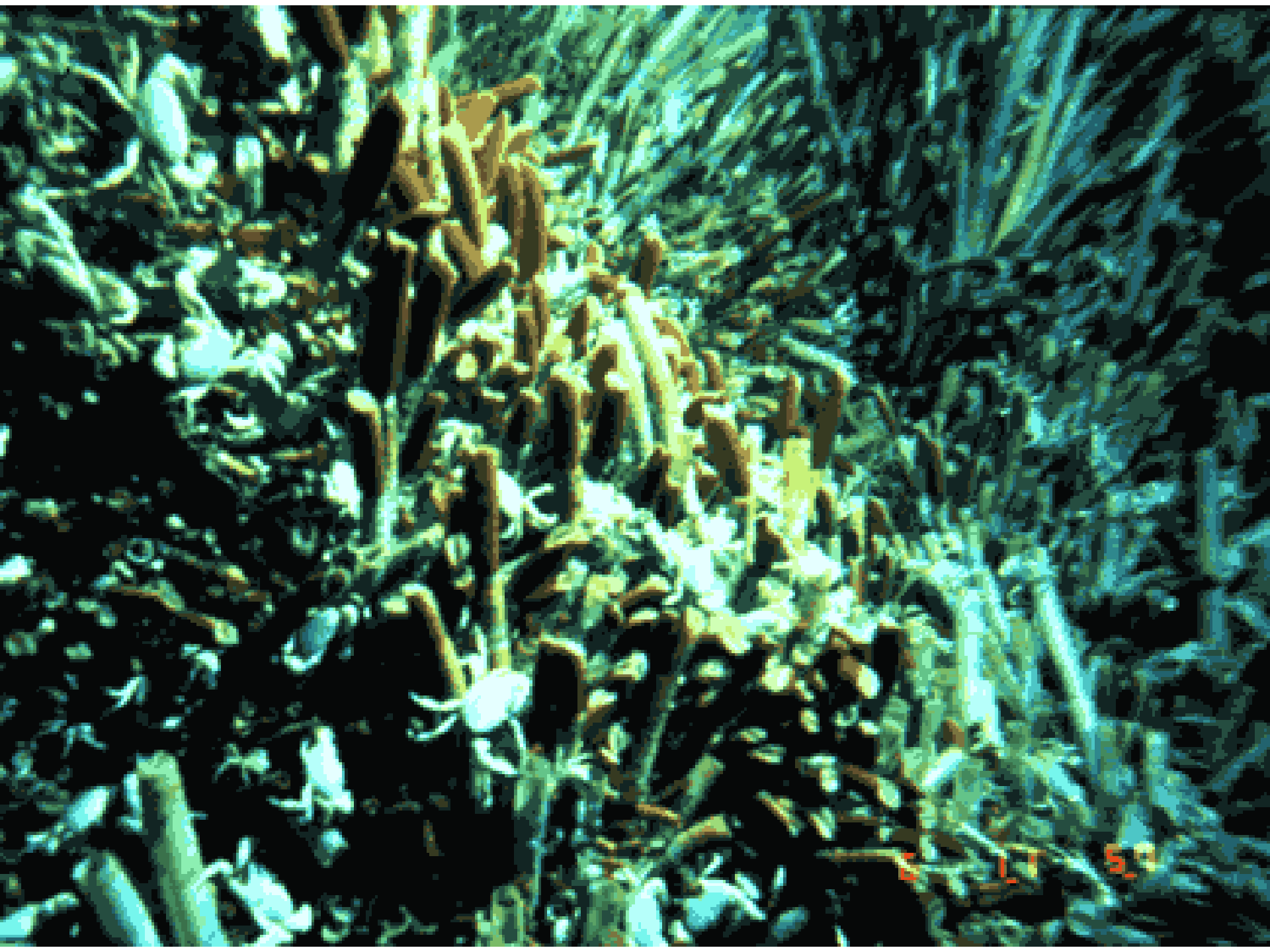


Polymetallic mineralization in a sedimented marginal basin ➔ broadly similar to the Iberian Pyrite Belt, the largest massive sulfide accumulation in the world

Sulfide talus at Hook Ridge (1060 m water depth)

Petersen et al. (2004)

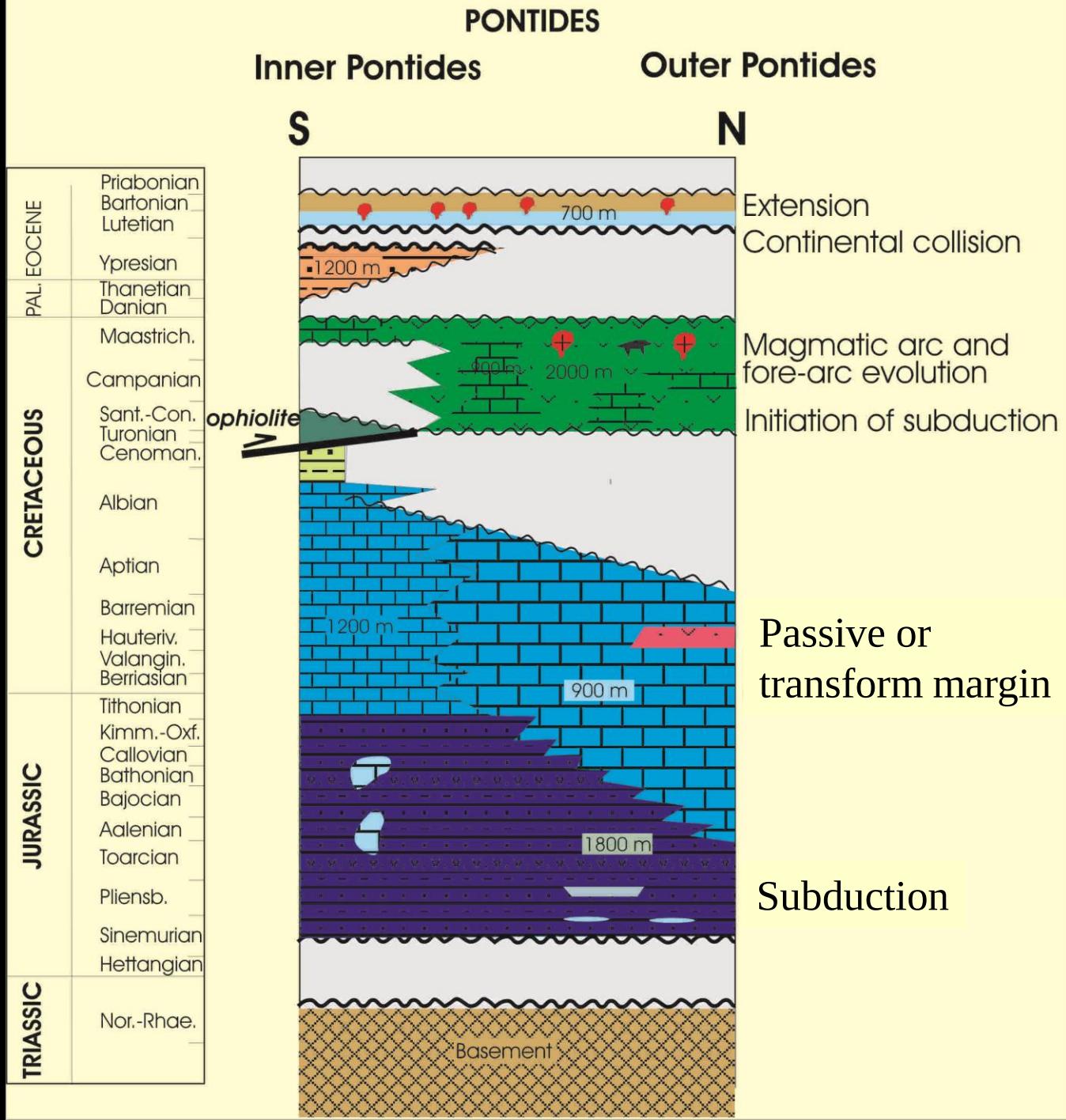





100
BİN LİRA
2000

MAASTRICHTIAN – PALEOCENE

END OF MAGMATISM – LIMESTONE DEPOSITION


PONTIDES
Inner Pontides
Outer Pontides
S
N
PAL. EOCENE
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Danian
CRETACEOUS
Maastrich.
Campanian
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Pliensb.
Sinemurian
Hettangian
TRIASSIC
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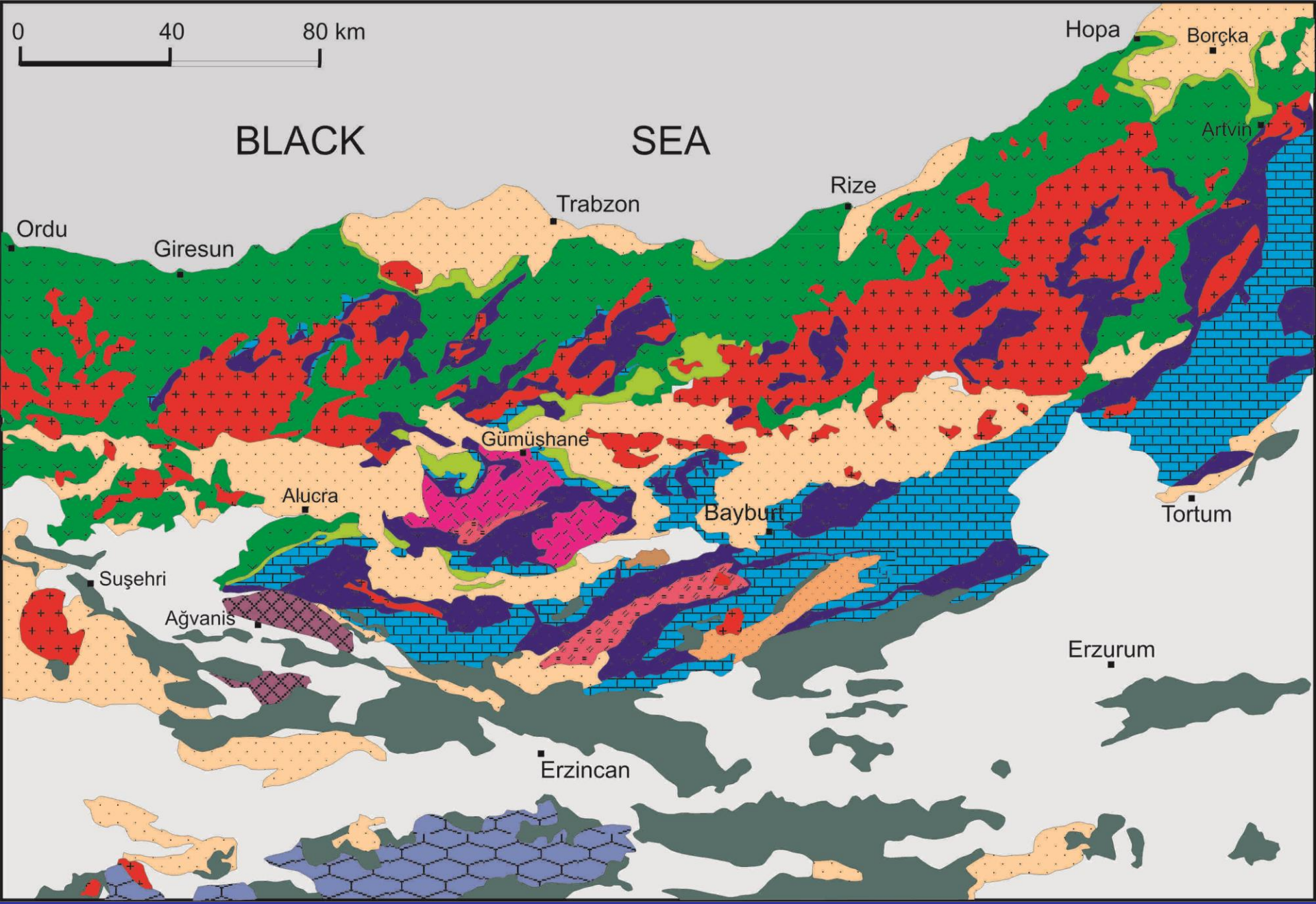
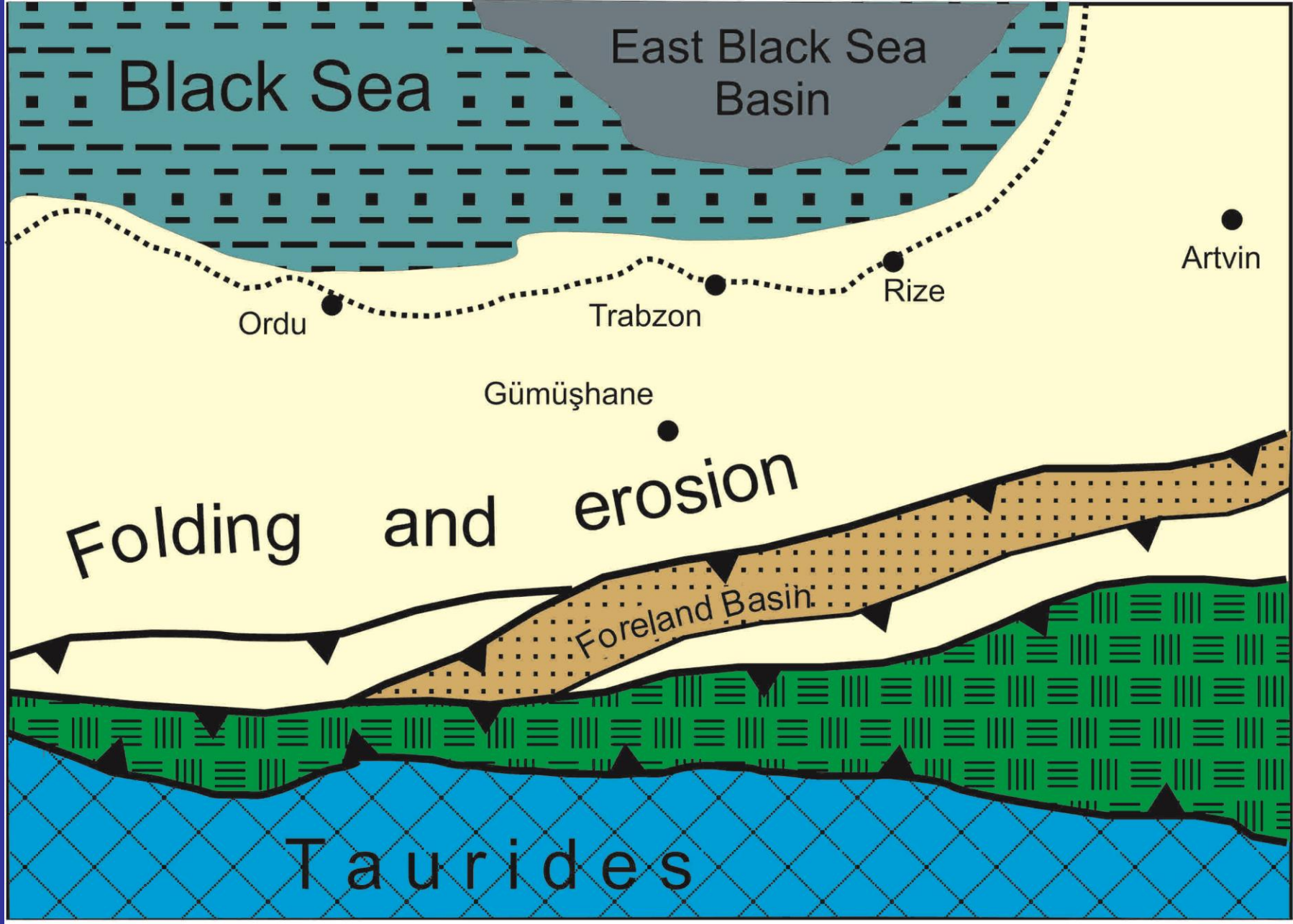
ophiolite
700 m
1200 m
900 m
2000 m
1200 m
900 m
1800 m
Basement
Extension
Continental collision
Magmatic arc and
fore-arc evolution
Initiation of subduction
Passive or
transform margin
Subduction


100
BİN LİRA
2021

LATE PALEOCENE – EARLY EOCENE

COLLISION BETWEEN THE PONTIDES AND THE ANATOLIDE-TAURIDE BLOCK


0
40
80 km
BLACK
SEA
Hopa
Borçka
Artvin
Rize
Trabzon
Ordu
Giresun
Gümüşhane
Alucra
Bayburt
Tortum
Suşehri
Ağvanis
Erzurum
Erzincan



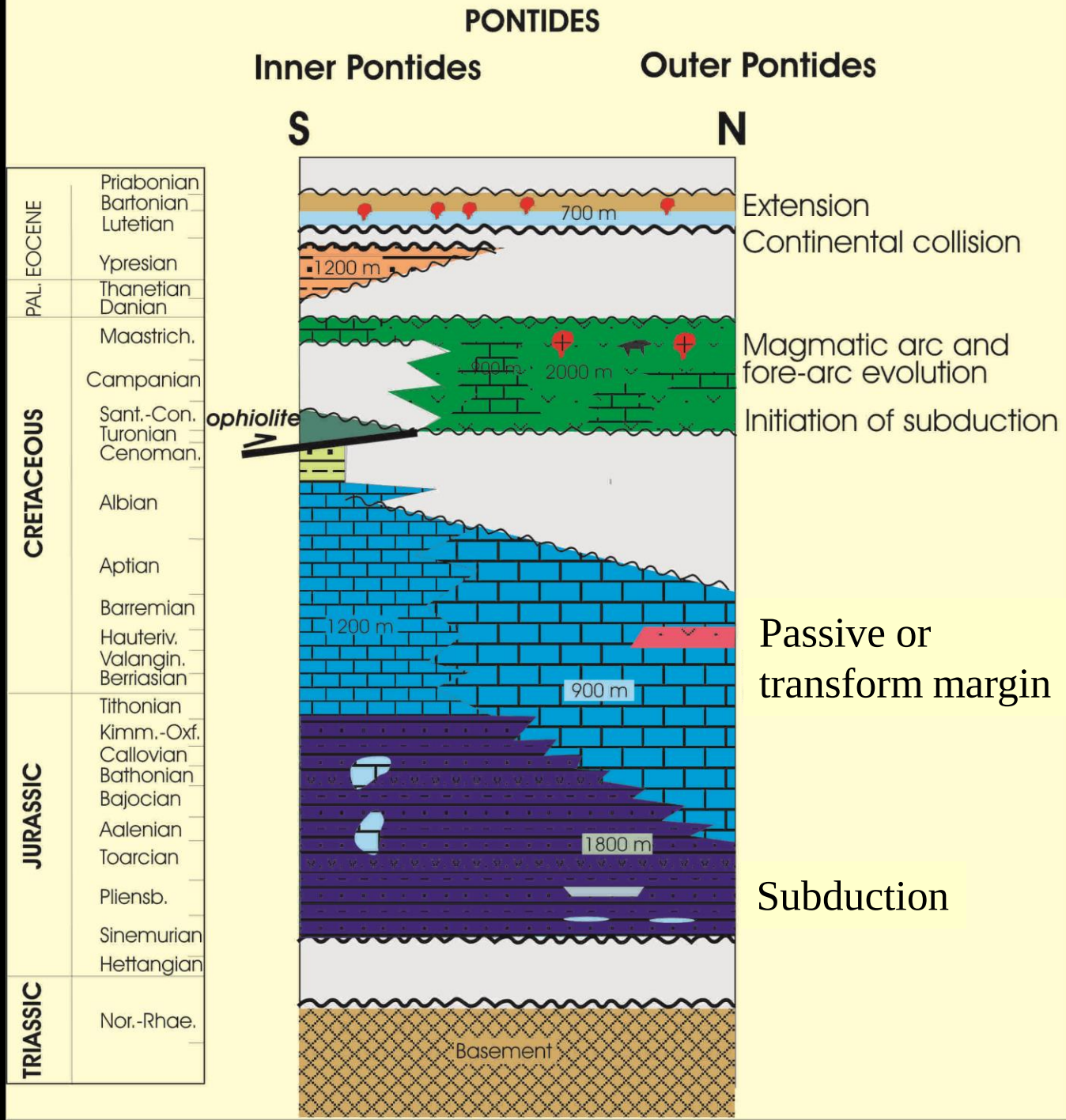
Early Eocene

100 km

MIDDLE – LATE EOCENE

POST-COLLISIONAL EXTENSION AND MAGMATISM

A NEW PHASE OF DEPOSITION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PAL. EOCENE
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CRETACEOUS
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Turonian
Cenoman.
Albian
Aptian
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Hauteriv.
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1800 m
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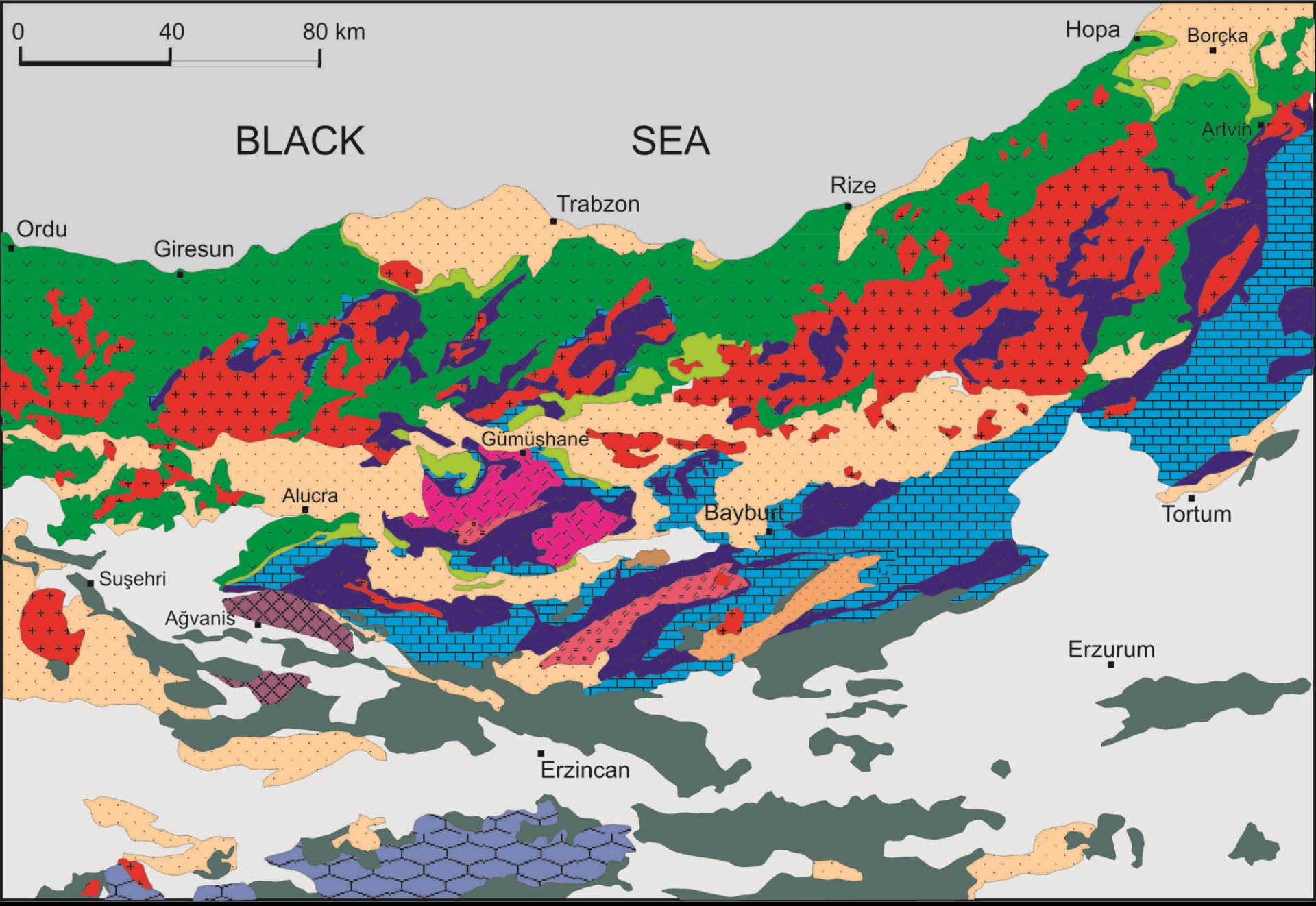
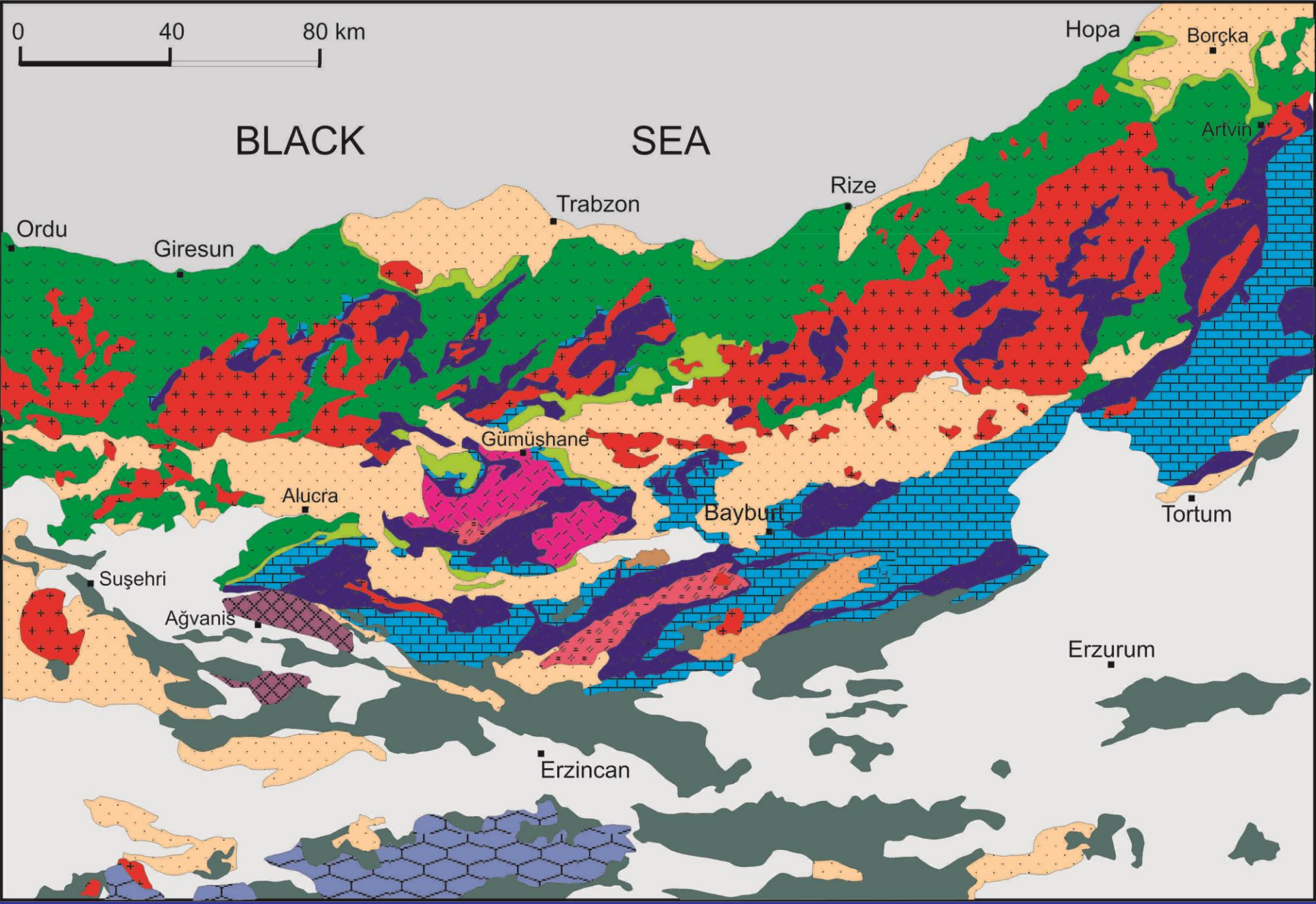
Magmatic arc and
fore-arc evolution
Initiation of subduction
Passive or
transform margin
Subduction


0
40
80 km
BLACK
SEA
Hopa
Borçka
Artvin
Rize
Trabzon
Ordu
Giresun
Gümüşhane
Alucra
Bayburt
Tortum
Suşehri
Ağvanis
Erzurum
Erzincan


0
40
80 km
BLACK
SEA
Hopa
Borçka
Artvin
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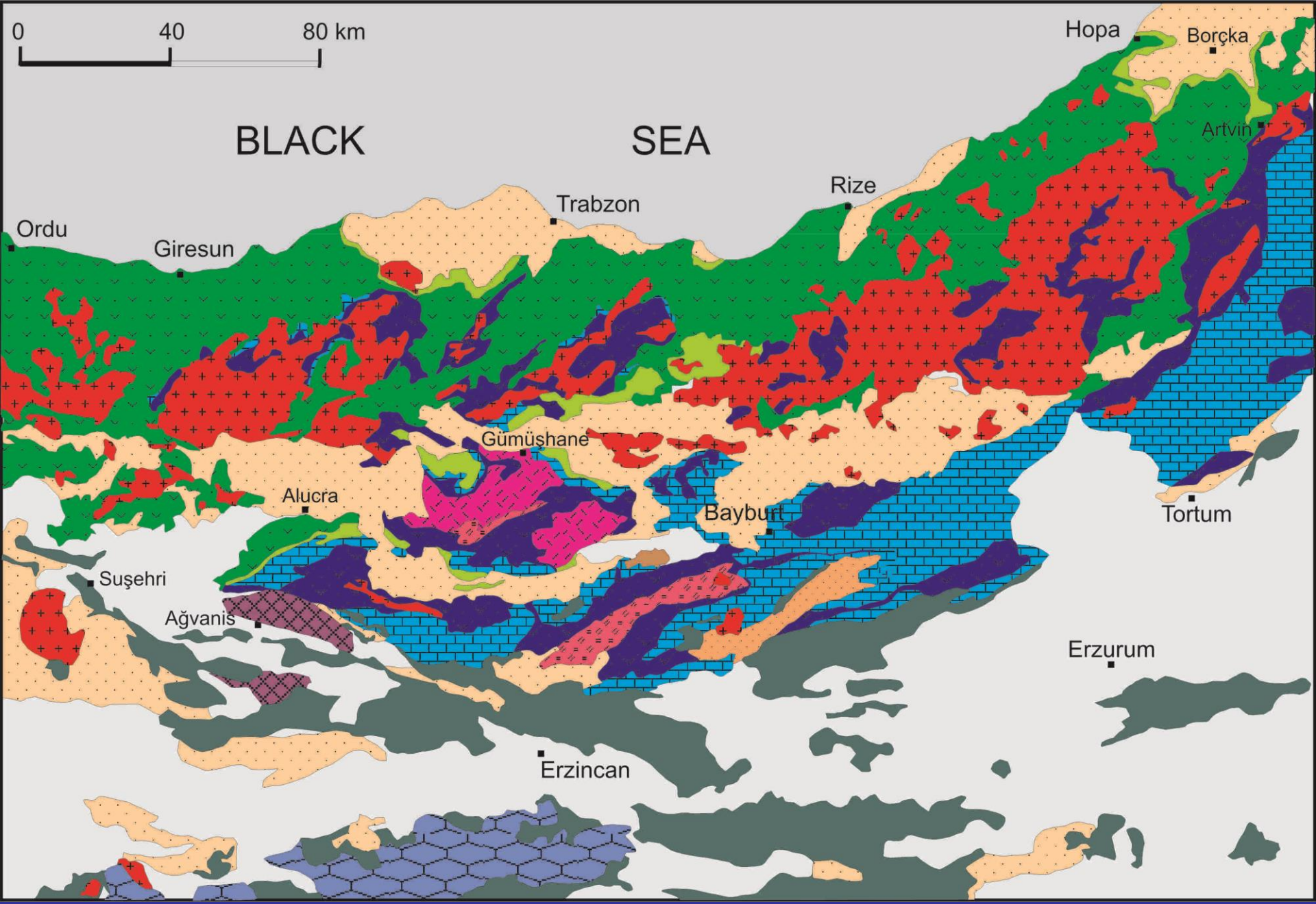
Trabzon
Ordu
Giresun
Gümüşhane
Alucra
Bayburt
Tortum
Suşehri
Ağvanis
Erzurum
Erzincan


0
40
80 km
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SEA
Hopa
Borçka
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Rize
Trabzon
Ordu
Giresun
Gümüşhane
Alucra
Bayburt
Tortum
Suşehri
Ağvanis
Erzurum
Erzincan

AFTER THE EOCENE

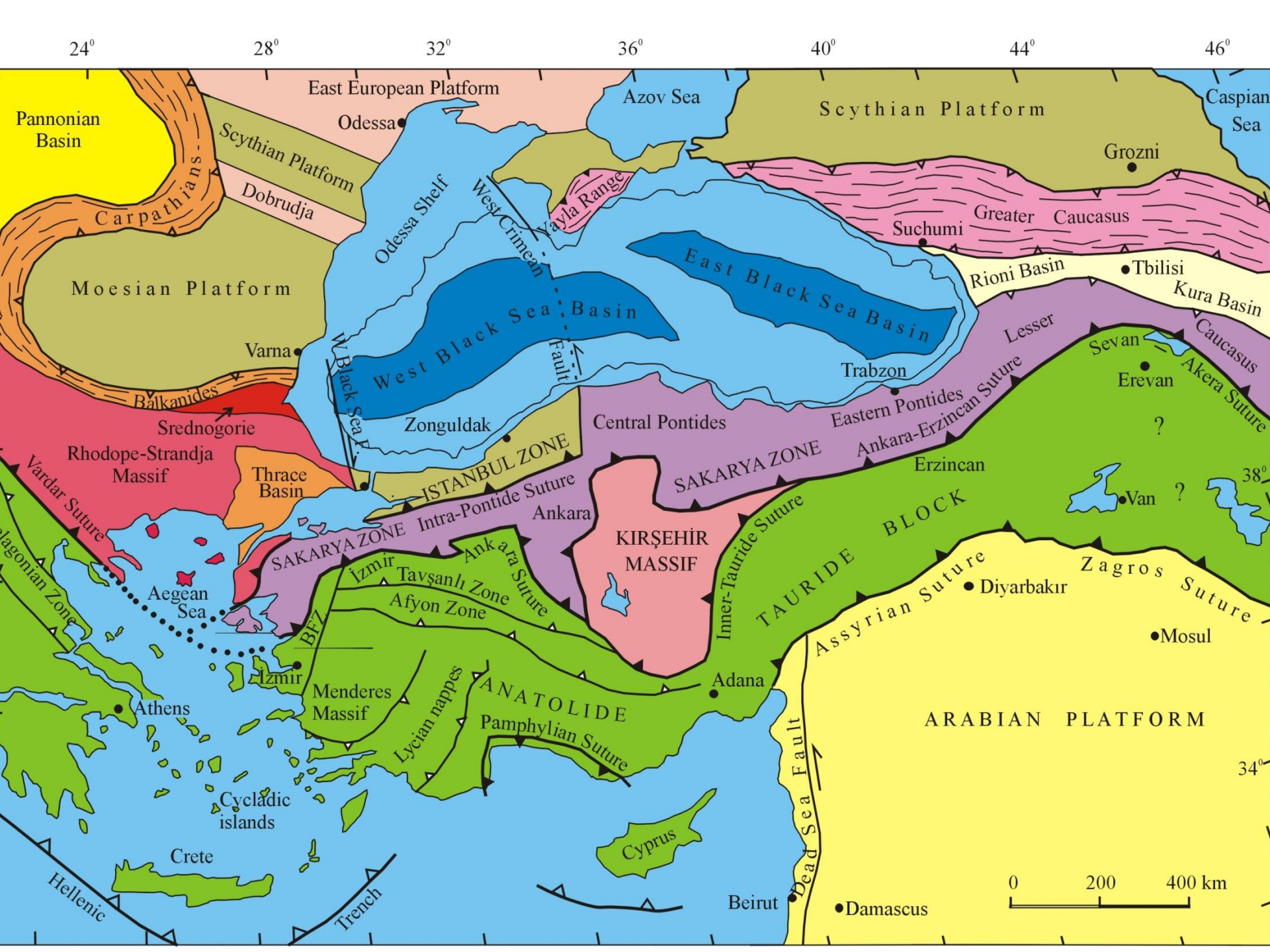
CONTINENTAL DEPOSITION AND VOLCANISM

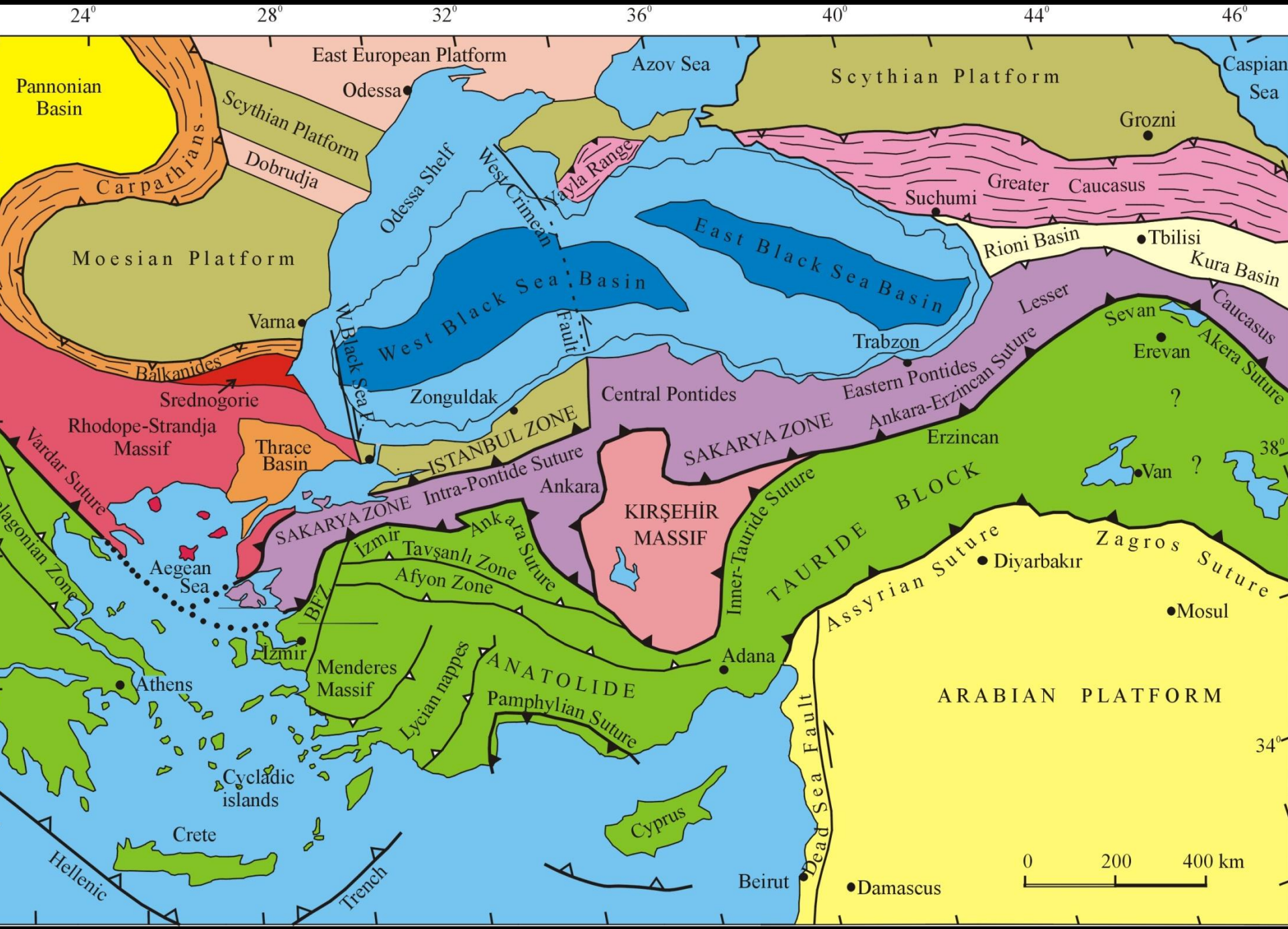
Main Tectonic Features of the Eastern Pontides

- - A complex and heterogeneous pre-Jurassic basement.
- - Volcanoclastic Early to Middle Jurassic – arc volcanism
- - Upper Jurassic – Lower Cretaceous carbonates – south-facing passive continental margin.
- - North-vergent emplacement of ophiolitic melange in Mid-Cretaceous.
- - Build-up of a magmatic arc in the Senonian. Formation of the Kuruko-type sulfide deposits.
- - Continent-arc collision in the Late Paleocene - Early Eocene.
- - Widespread post-collisional magmatism and sedimentation in the Mid-Eocene.


Red pelagic limestones


flysch


24°
28°
32°
36°
40°
44°
46°
Pannonian Basin
East European Platform
Odessa
Azov Sea
Scythian Platform
Caspian Sea
Grozni
Carpathians
Scythian Platform
Dobrudja
Odessa Shelf
West Crimean Fault
Yayla Range
Greater Caucasus
Suchumi
Rioni Basin
Tbilisi
Kura Basin
Moesian Platform
West Black Sea Basin
East Black Sea Basin
Lesser Caucasus
Varna
W Black Sea F.
Fault
Trabzon
Sevan
Erevan
Akera Suture
Balkanides
Srednogorie
Zonguldak
Central Pontides
Eastern Pontides
Ankara-Erzincan Suture
?
Rhodope-Strandja Massif
Thrace Basin
ISTANBUL ZONE
SAKARYA ZONE
Erzincan
Vardar Suture
Intra-Pontide Suture
Ankara
38°
Van
?
KIRŞEHİR MASSIF
Inner-Tauride Suture
TAURIDE BLOCK
SAKARYA ZONE
İzmir
Ankara Suture
Tavşanlı Zone
Afyon Zone
Assyrian Suture
Zagros Suture
Diyarbakır
Aegean Sea
BFZ
Mosul
İzmir
Menderes Massif
Lycian nappes
ANATOLIDE
Adana
Athens
Pamphylian Suture
ARABIAN PLATFORM
Cycladic islands
Dead Sea Fault
34°
Cyprus
Crete
Hellenic Trench
Beirut
Damascus
0
200
400 km


24°
28°
32°
36°
40°
44°
46°
East European Platform
Azov Sea
Scythian Platform
Caspian Sea
Pannonian Basin
Odessa
Grozni
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