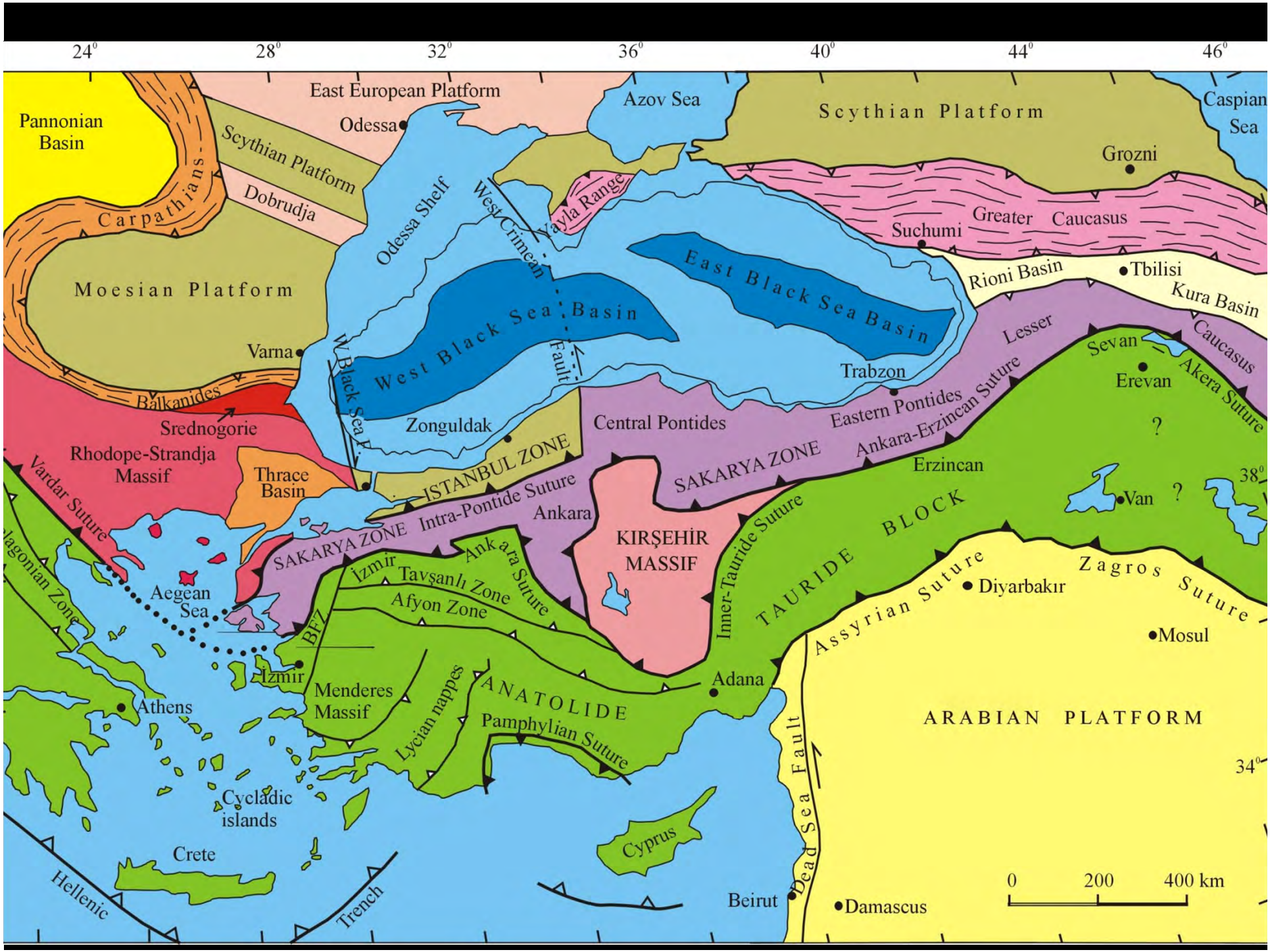
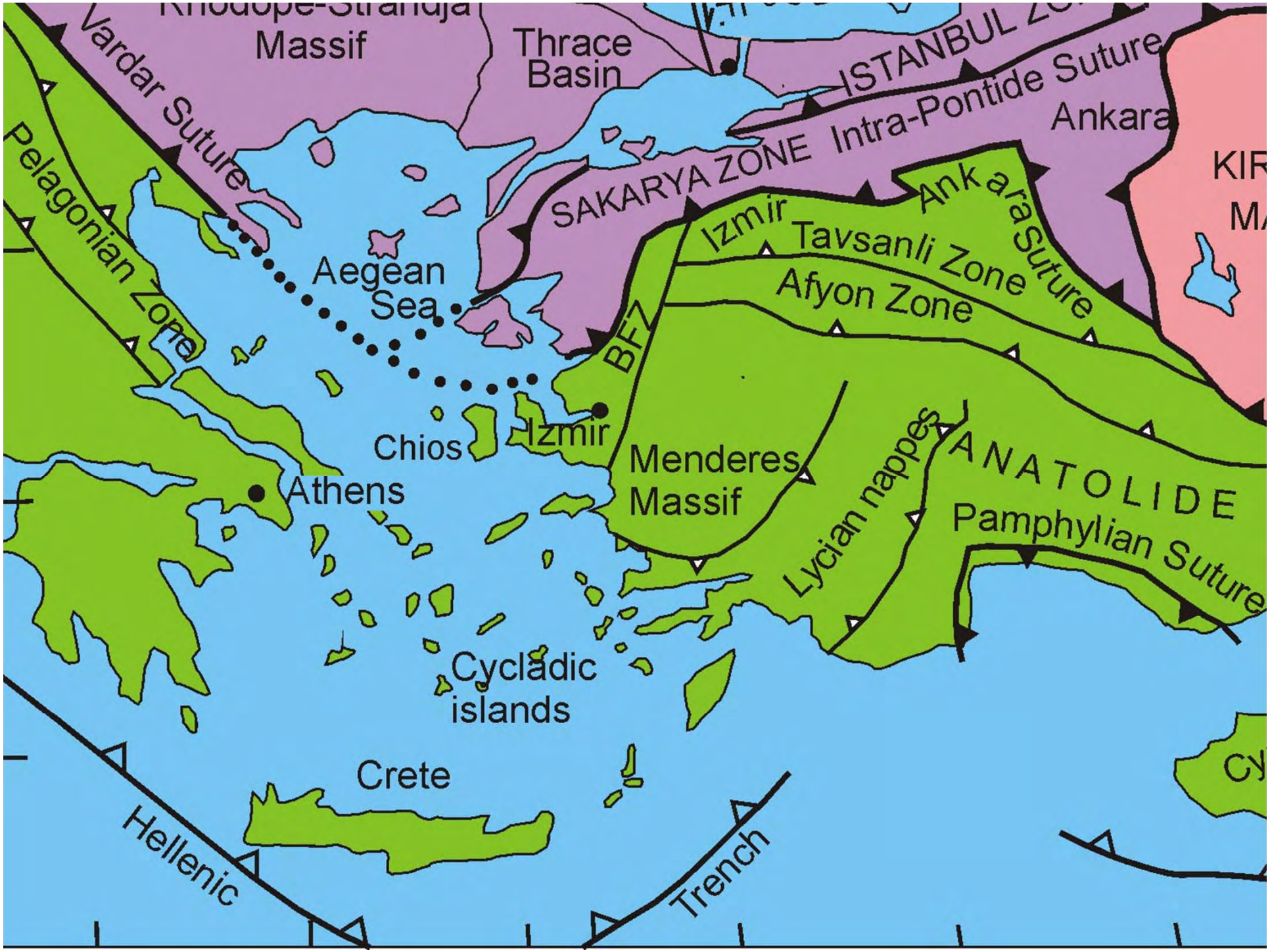
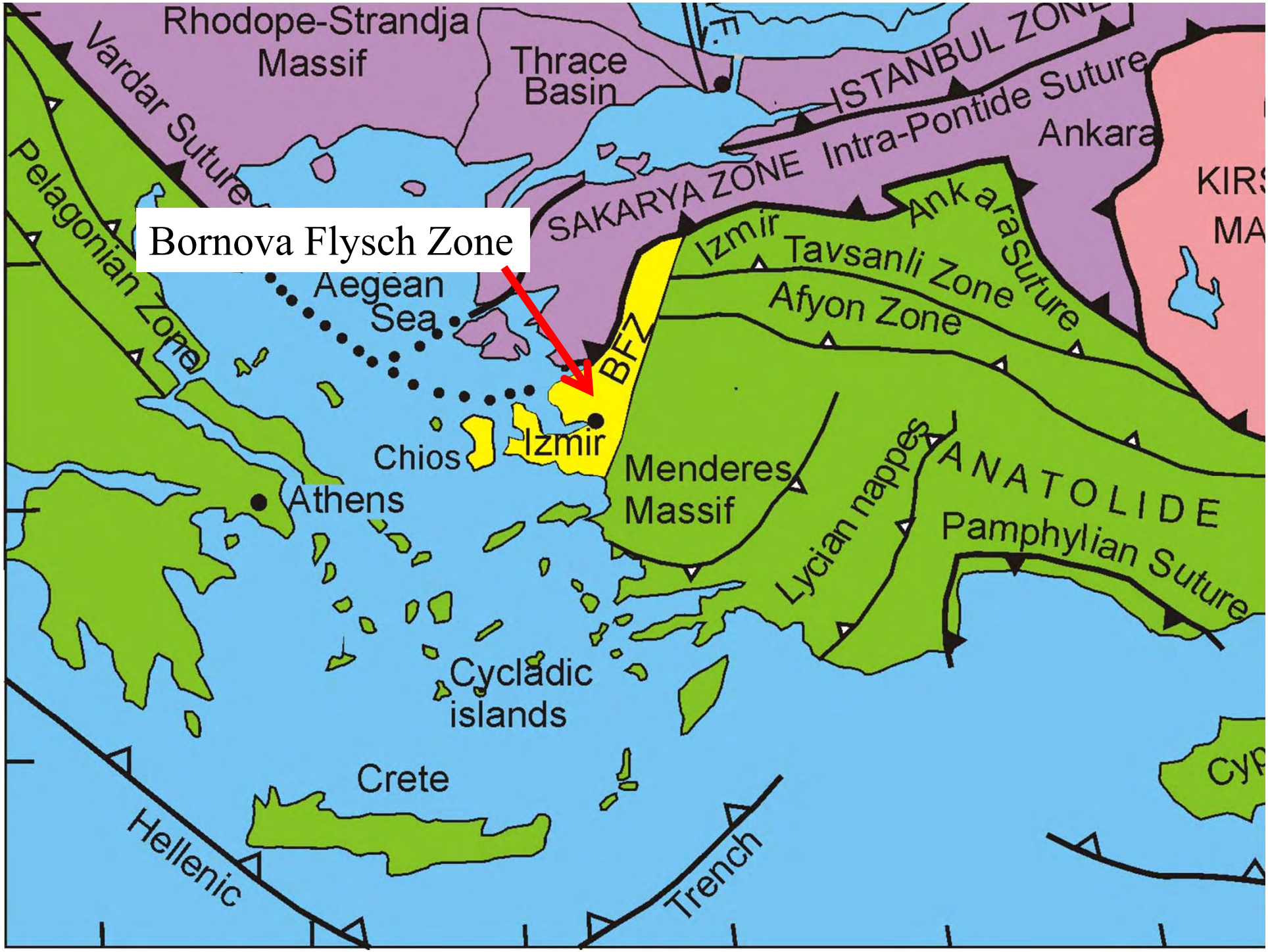
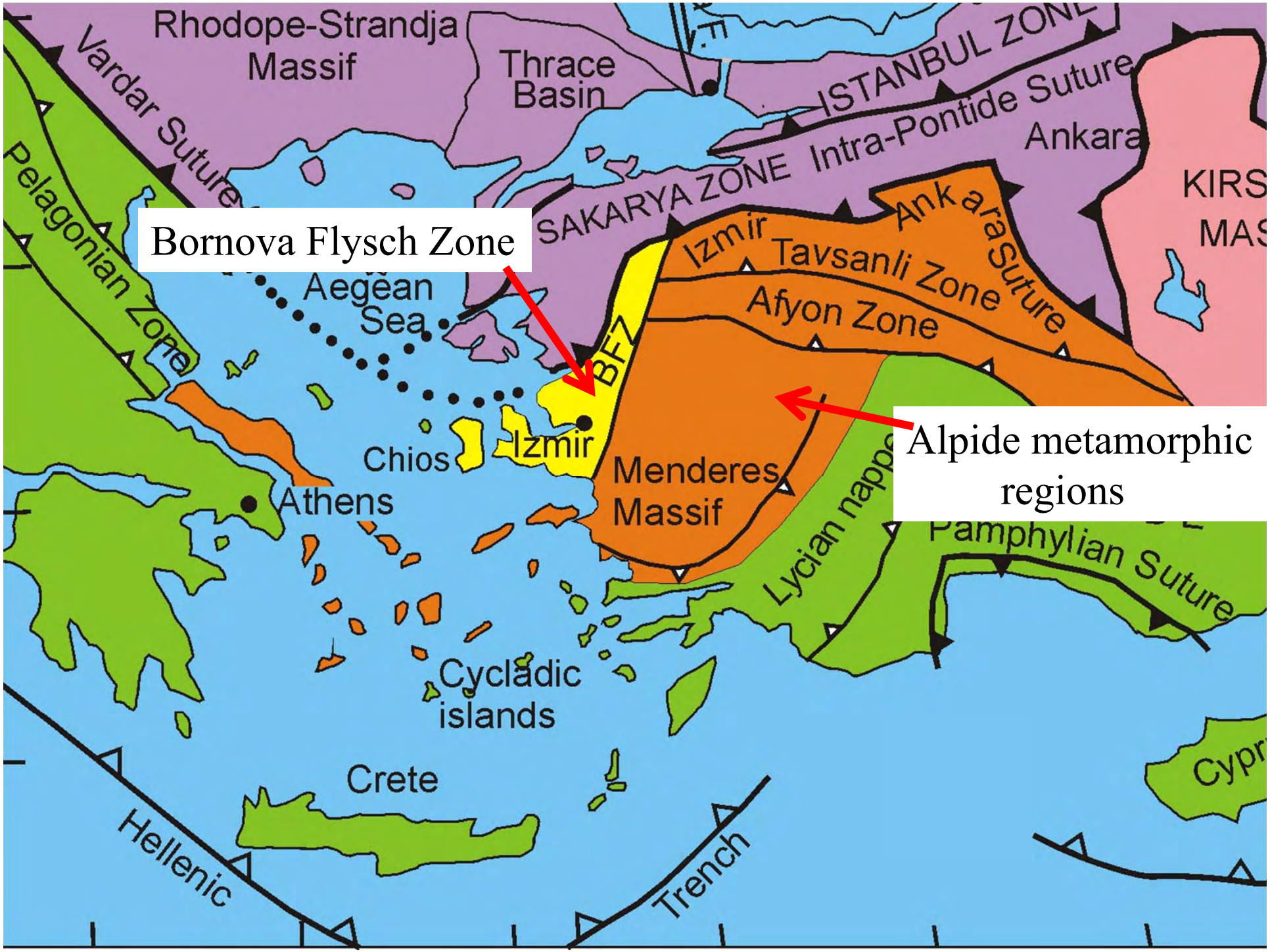
Bornova Flysch Zone
A large melange – olistostrome belt

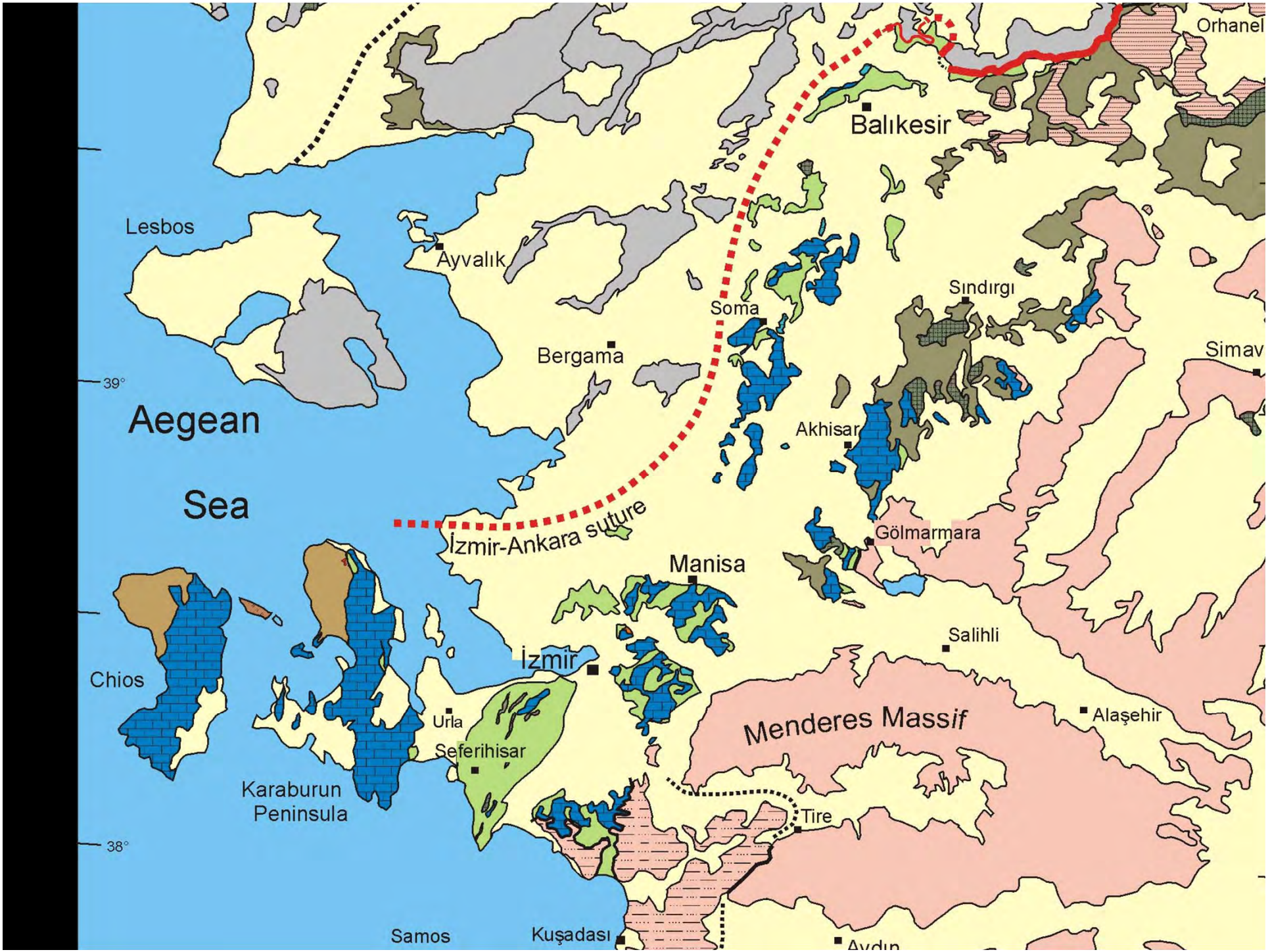
Aral Okay
Istanbul Teknik Üniversitesi


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

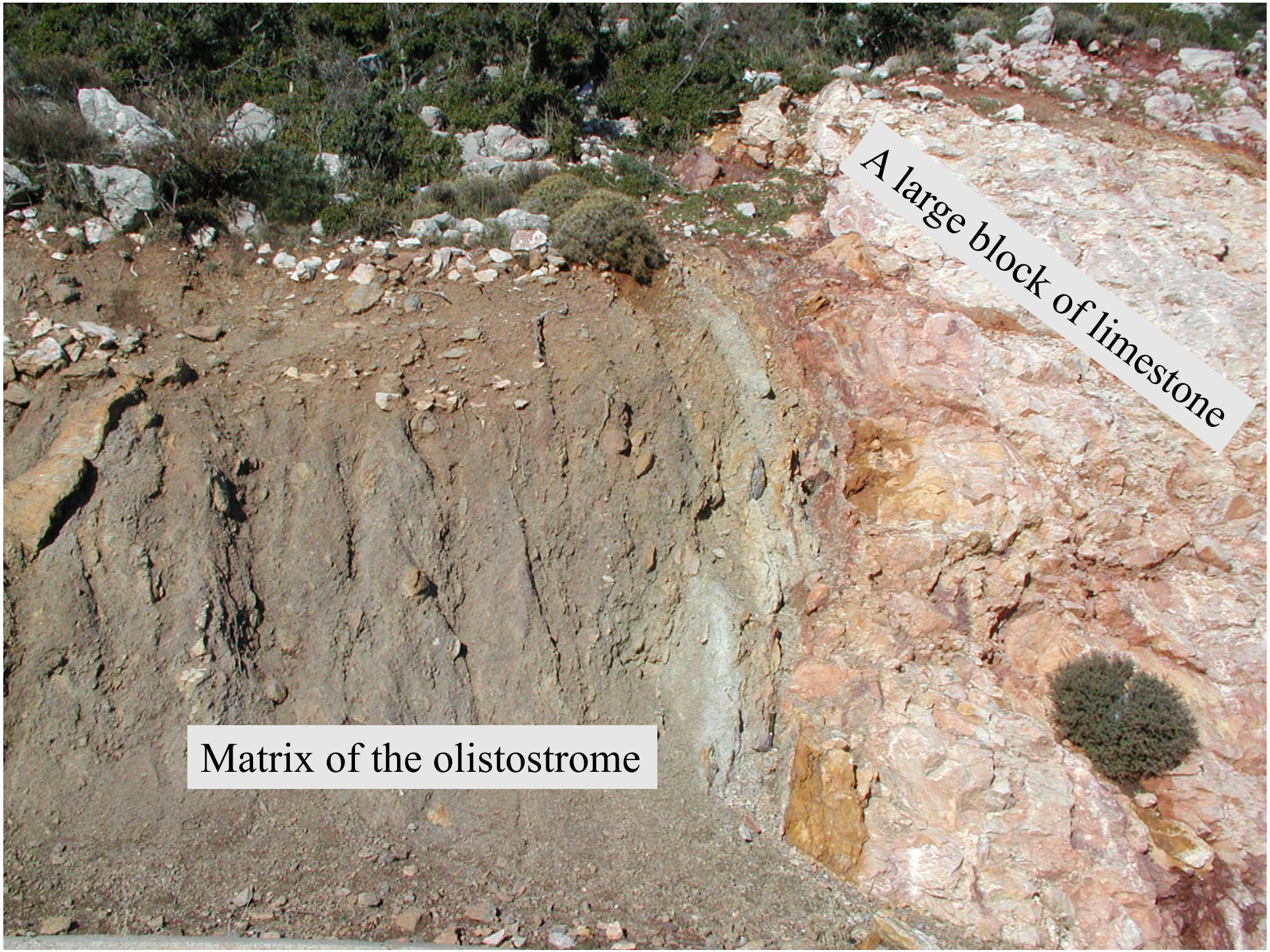

Rhodope-Strandja
Massif
Vardar Suture
Thrace
Basin
ISTANBUL ZONE
Intra-Pontide Suture
Ankara
KIR
MA
Pelagonian Zone
SAKARYA ZONE
Izmir
Tavsanli Zone
Ankara Suture
Afyon Zone
Aegean
Sea
BFZ
Chios
Izmir
Menderes
Massif
Lycian nappes
ANATOLIDE
Pamphylian Suture
Athens
Cycladic
islands
Crete
Hellenic
Trench

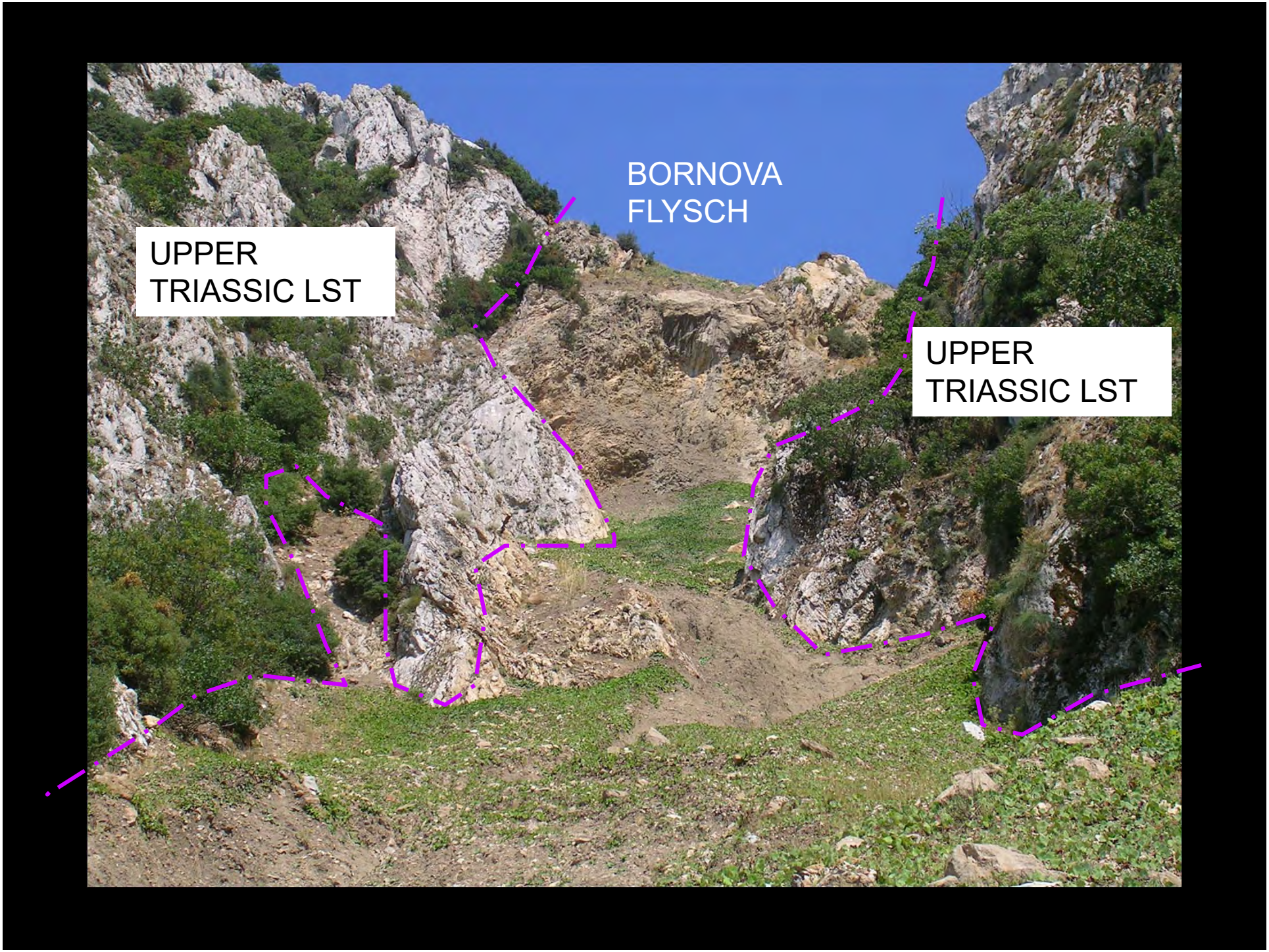

Rhodope-Strandja Massif
Vardar Suture
Thrace Basin
ISTANBUL ZONE
Intra-Pontide Suture
Ankara
Pelagonian Zone
SAKARYA ZONE
Bornova Flysch Zone
Izmir
Tavsanli Zone
Ankara Suture
Afyon Zone
Aegean Sea
BFZ
Chios
Izmir
Menderes Massif
Lycian nappes
ANATOLIDE
Pamphylian Suture
Athens
Cycladic islands
Crete
Hellenic
Trench

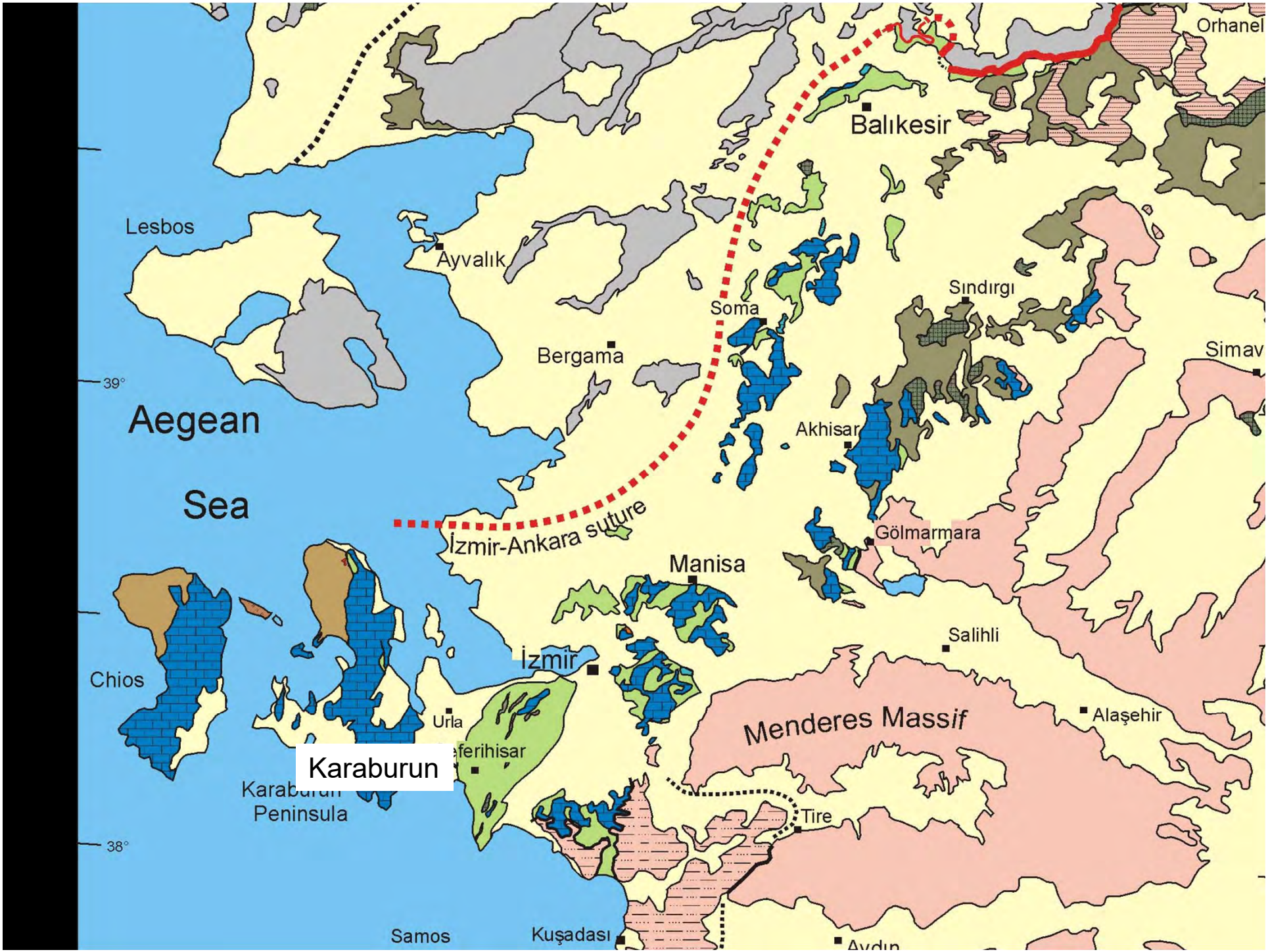

Rhodope-Strandja Massif
Vardar Suture
Thrace Basin
ISTANBUL ZONE
Intra-Pontide Suture
Ankara
KIRS
MAS
Pelagonian Zone
SAKARYA ZONE
Ankara Suture
Izmir
Tavsanli Zone
Afyon Zone
Bornova Flysch Zone
Aegean Sea
BFZ
Chios
Izmir
Menderes Massif
Alpide metamorphic regions
Athens
Lycian nappe
Pamphylian Suture
Cycladic islands
Crete
Hellenic
Trench
Cypr


Orhanel
Balıkesir
Lesbos
Ayvalık
Soma
Sındırgı
Bergama
Simav
39°
Aegean
Sea
Akhisar
İzmir-Ankara suture
Gölmarmara
Manisa
Salihli
İzmir
Chios
Urla
Menderes Massif
Alaşehir
Seferihisar
Karaburun
Peninsula
Tire
38°
Samos
Kuşadası
Aydın

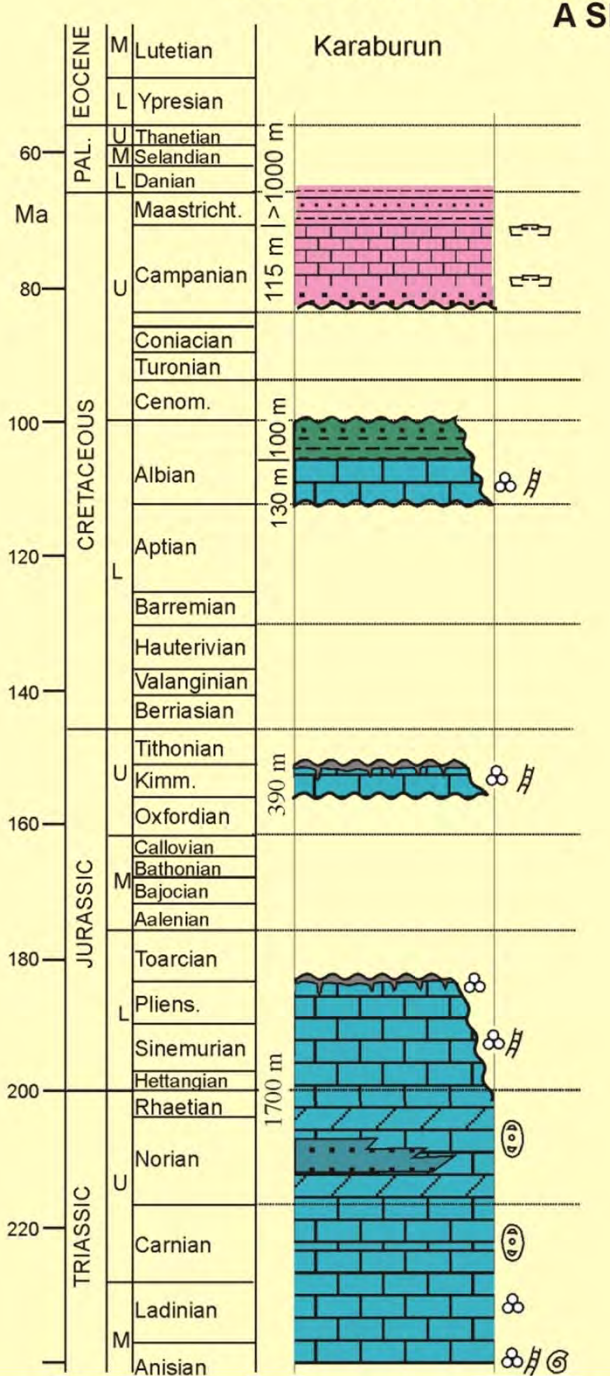
Debris flows - olistostromes


A large block of limestone
Matrix of the olistostrome


BORNOVA
FLYSCH
UPPER
TRIASSIC LST
UPPER
TRIASSIC LST


Orhanel
Balıkesir
Lesbos
Ayvalık
Soma
Sındırgı
Bergama
Simav
39°
Aegean
Sea
Akhisar
İzmir-Ankara suture
Gölmarmara
Manisa
Salihli
İzmir
Chios
Urla
Menderes Massif
Alaşehir
Karaburun
Karaburun
Peninsula
Tire
38°
Samos
Kuşadası

KARABURUN STRATIGRAPHY
A SEMI-INTACT CARBONATE PLATFORM



Sandstone

Deep marine red limestone

Dolomite

Bauxite

Shallow marine limestone

Foraminifera *Aulotortus* *Cladocoropsis*

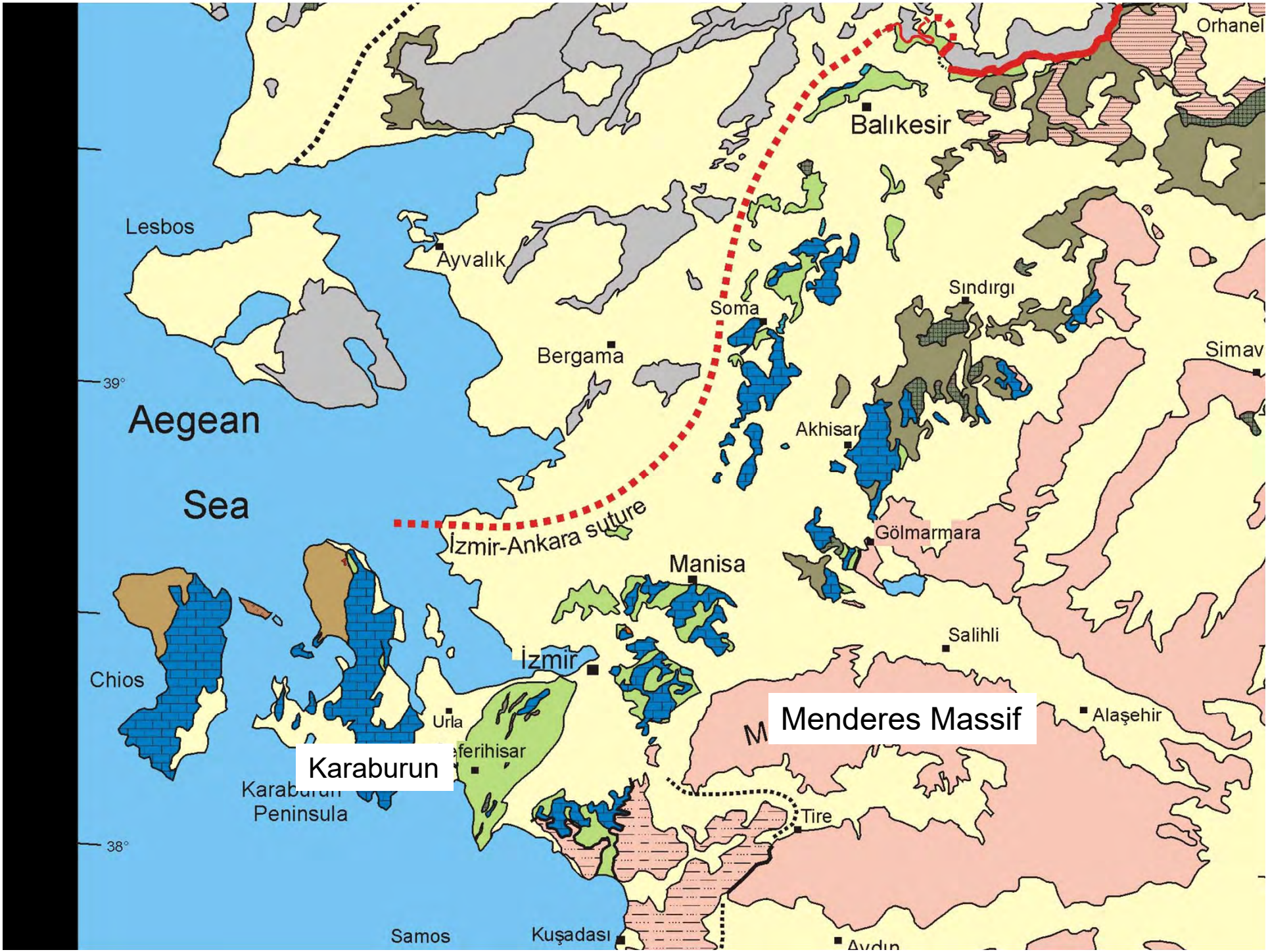
Calpionella *Favusella* *Rotalipora*

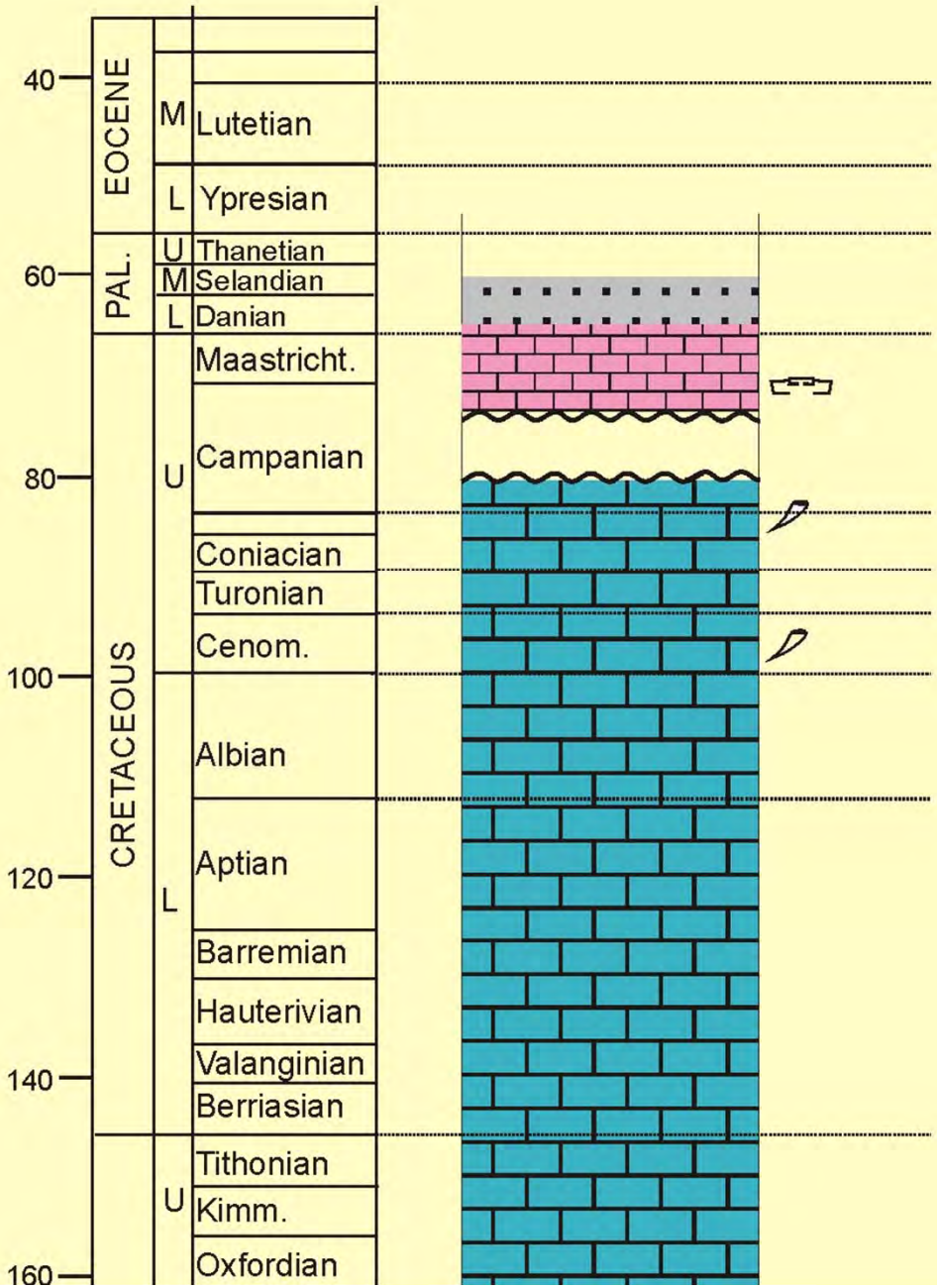
Algs Coral Belemnite

Radiolaria Rudists Ammonoid Aptychus

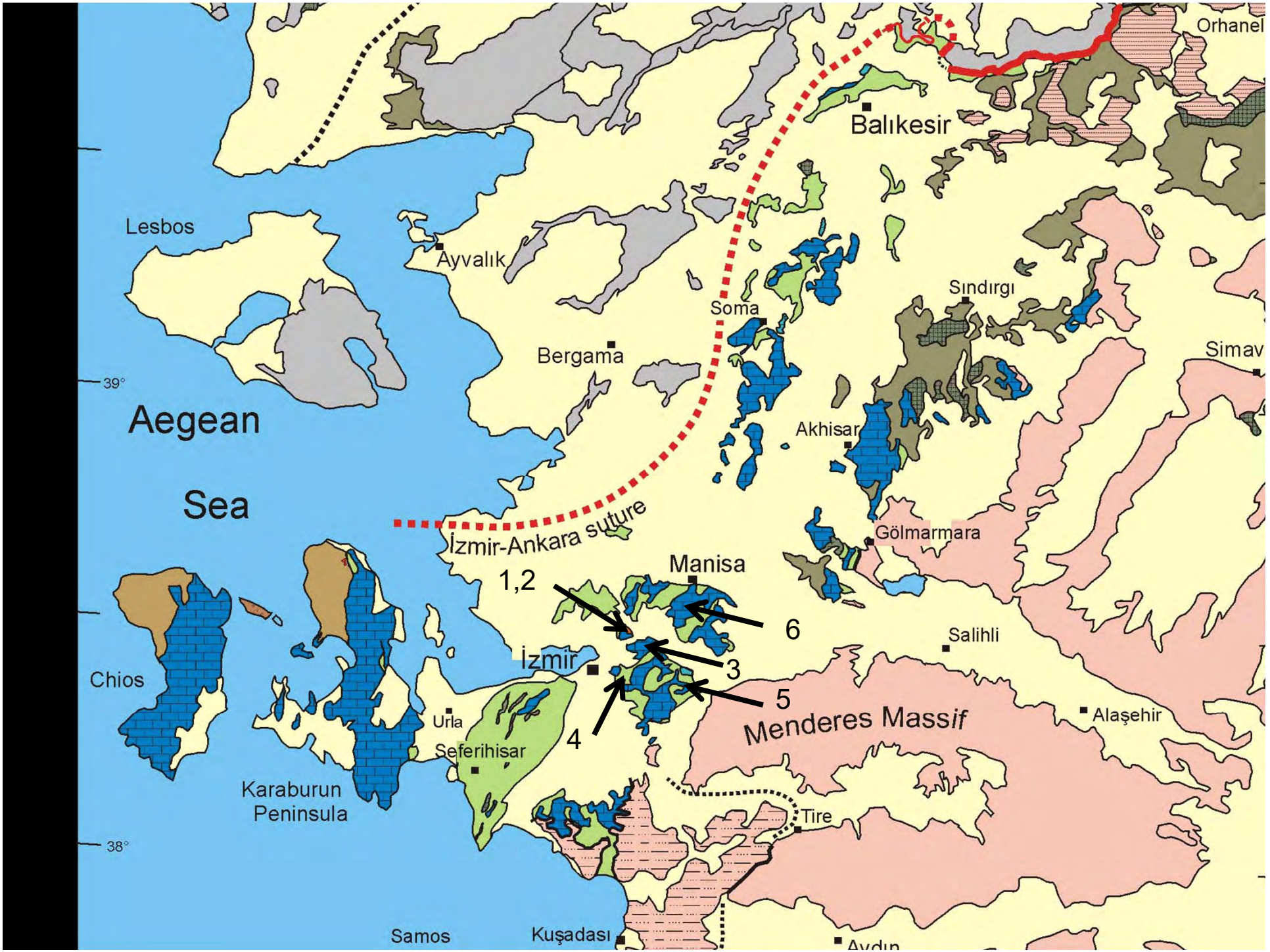
Globotruncana Thin-shelled pelecypod

Unconformity

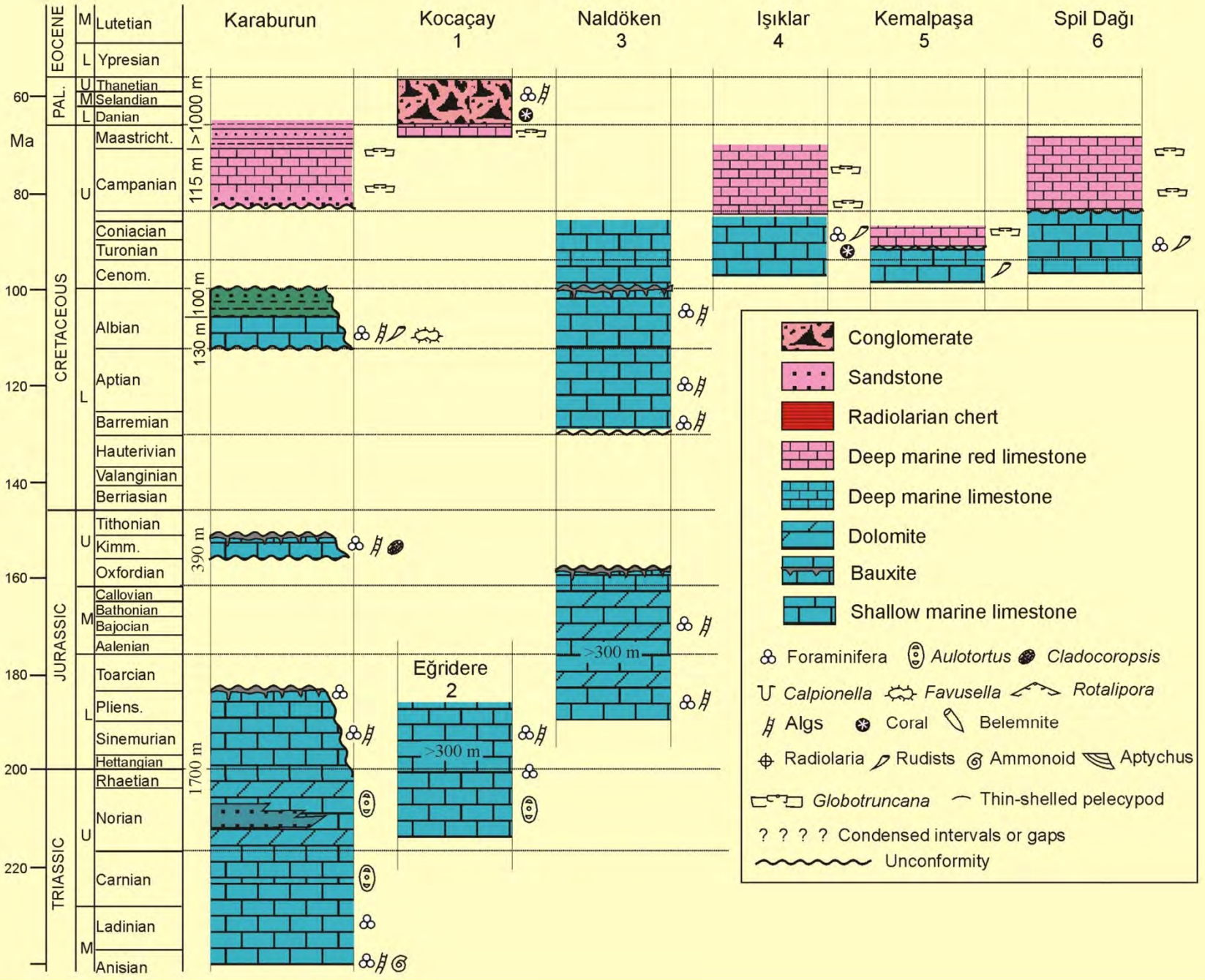

Orhanel
Balıkesir
Lesbos
Ayvalık
Soma
Sındırgı
Bergama
Simav
39°
Aegean
Sea
Akhisar
İzmir-Ankara suture
Gölmarmara
Manisa
Salihli
İzmir
Chios
Urla
Menderes Massif
Alaşehir
Karaburun
Karaburun
Peninsula
Tire
38°
Samos
Kuşadası

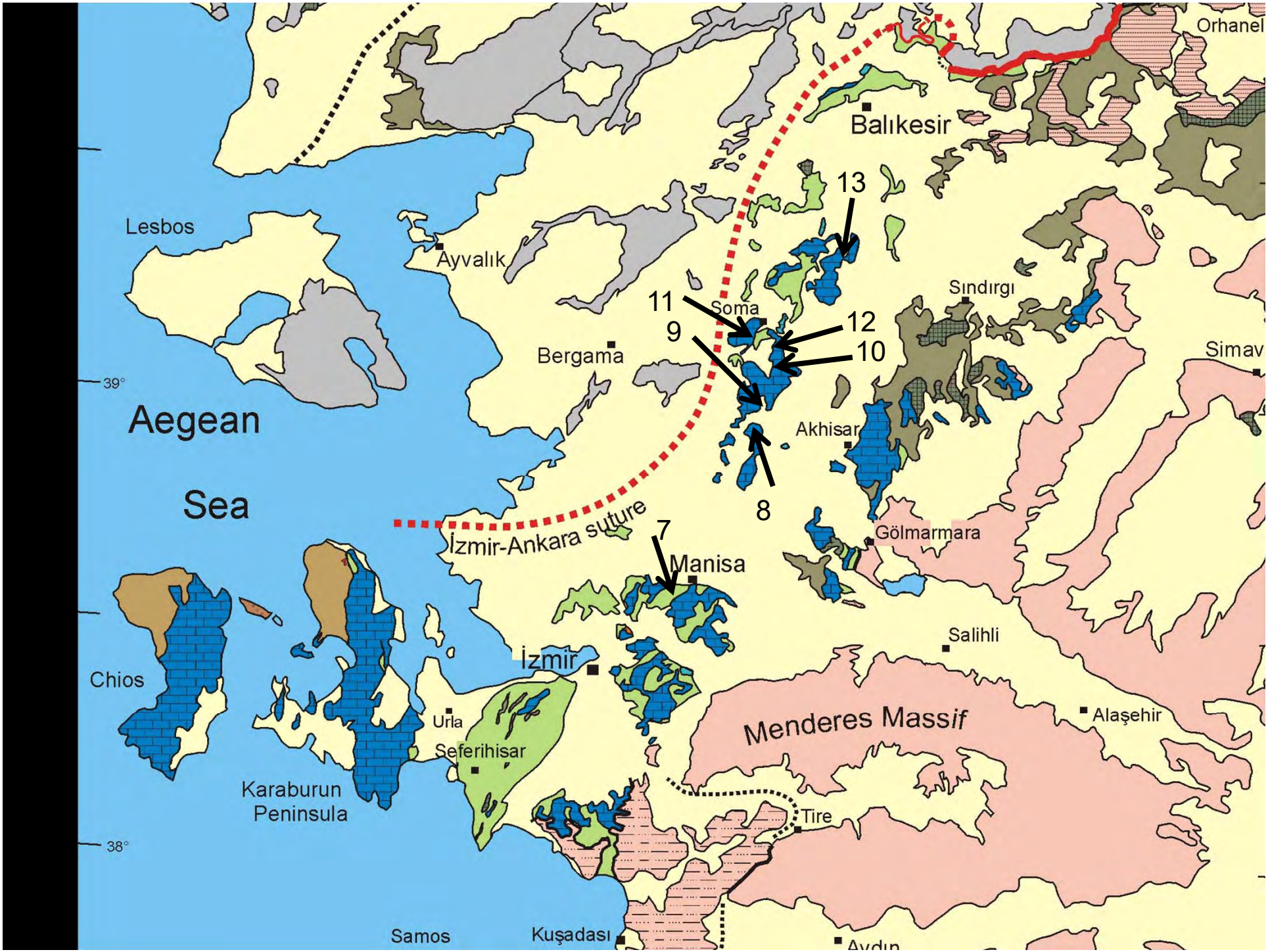


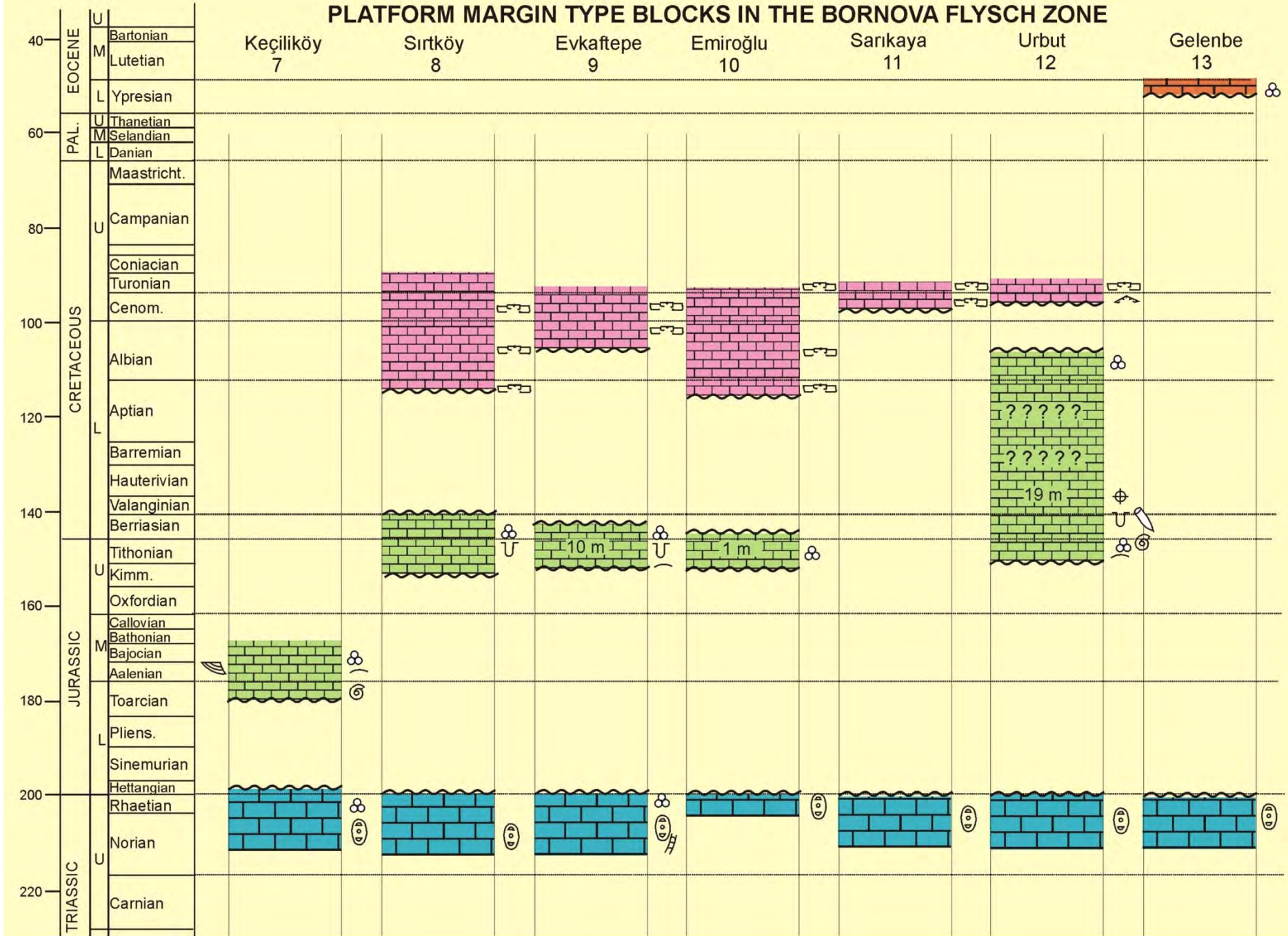
Menderes Massif

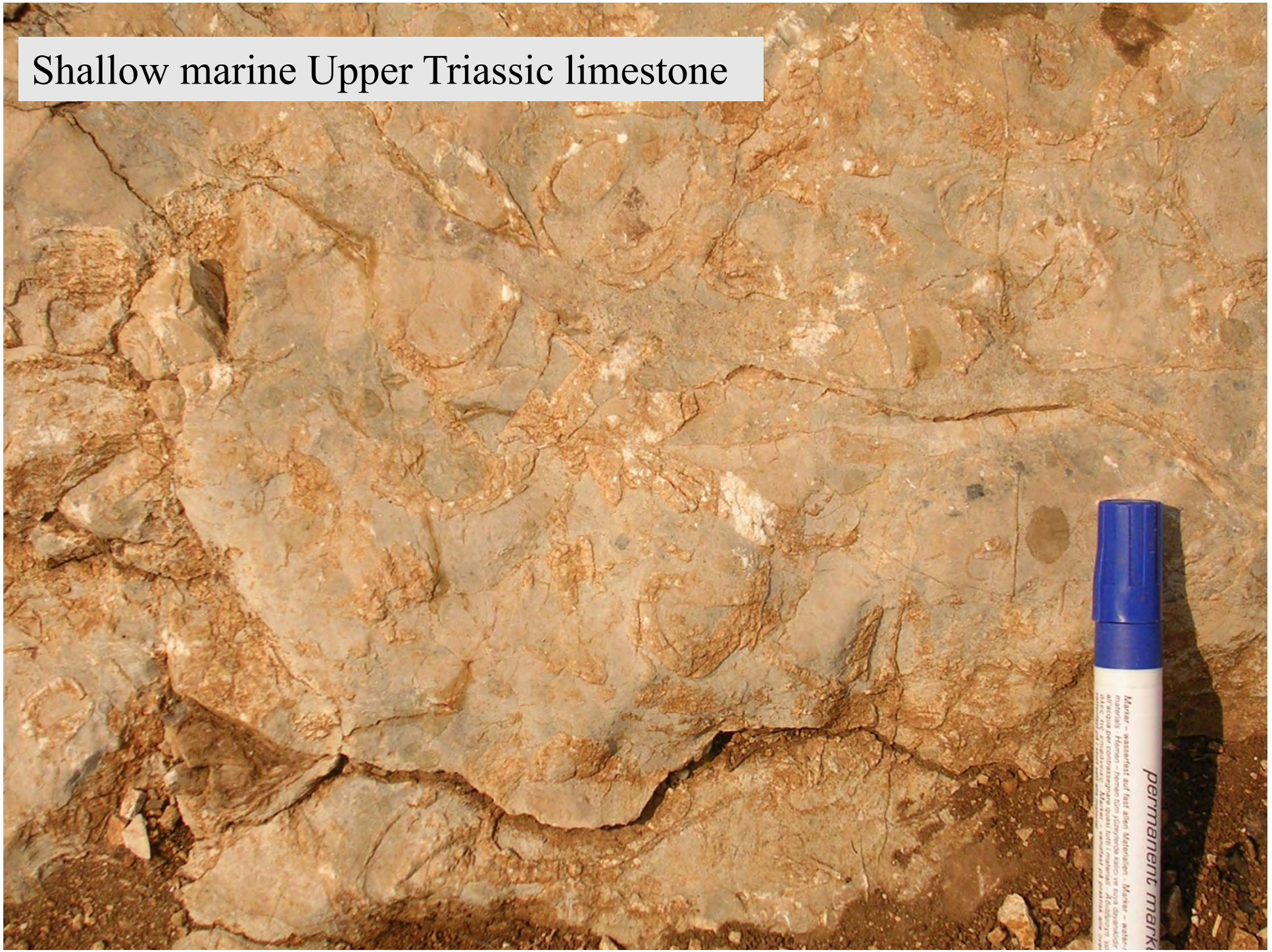

Orhanel
Balıkesir
Lesbos
Ayvalık
Soma
Sındırgı
Bergama
Simav
39°
Aegean
Sea
Akhisar
İzmir-Ankara suture
Gölmarmara
Manisa
1,2
6
Salihli
İzmir
3
5
Chios
Menderes Massif
Alaşehir
Urla
Seferihisar
4
Karaburun
Peninsula
Tire
38°
Samos
Kuşadası
Aydın

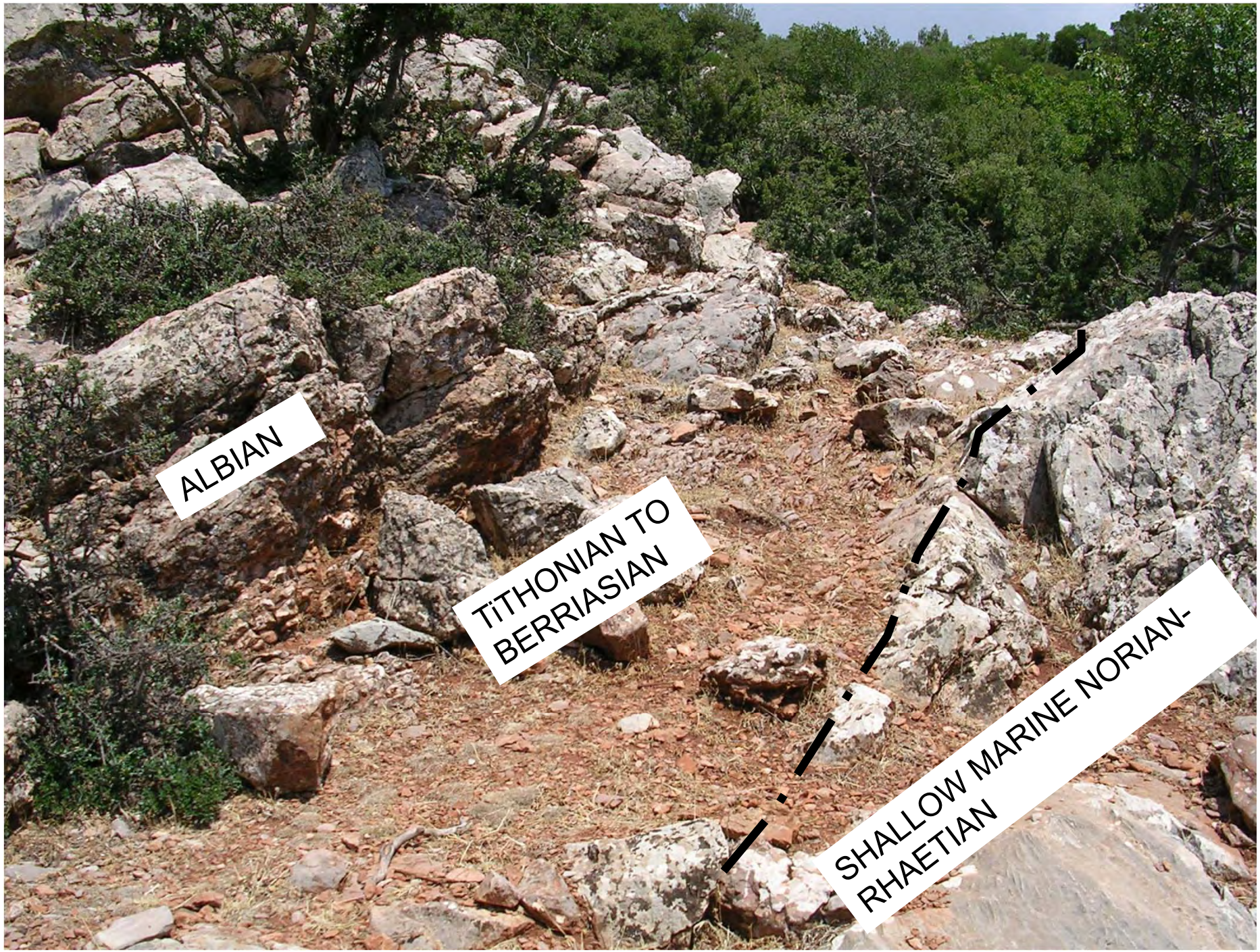
KARABURUN AND PLATFORM TYPE BLOCKS IN THE BORNOVA FLYSCH ZONE

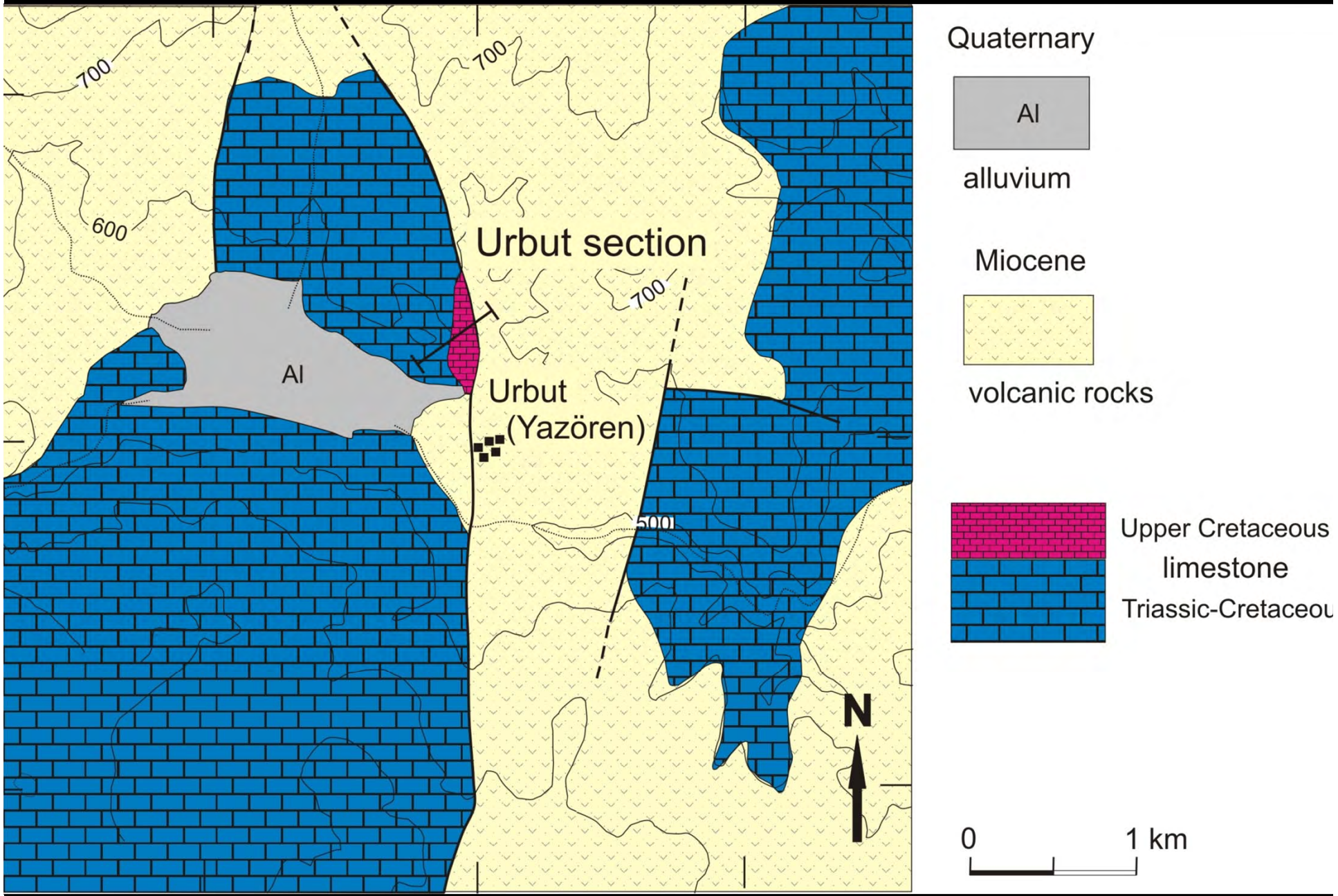


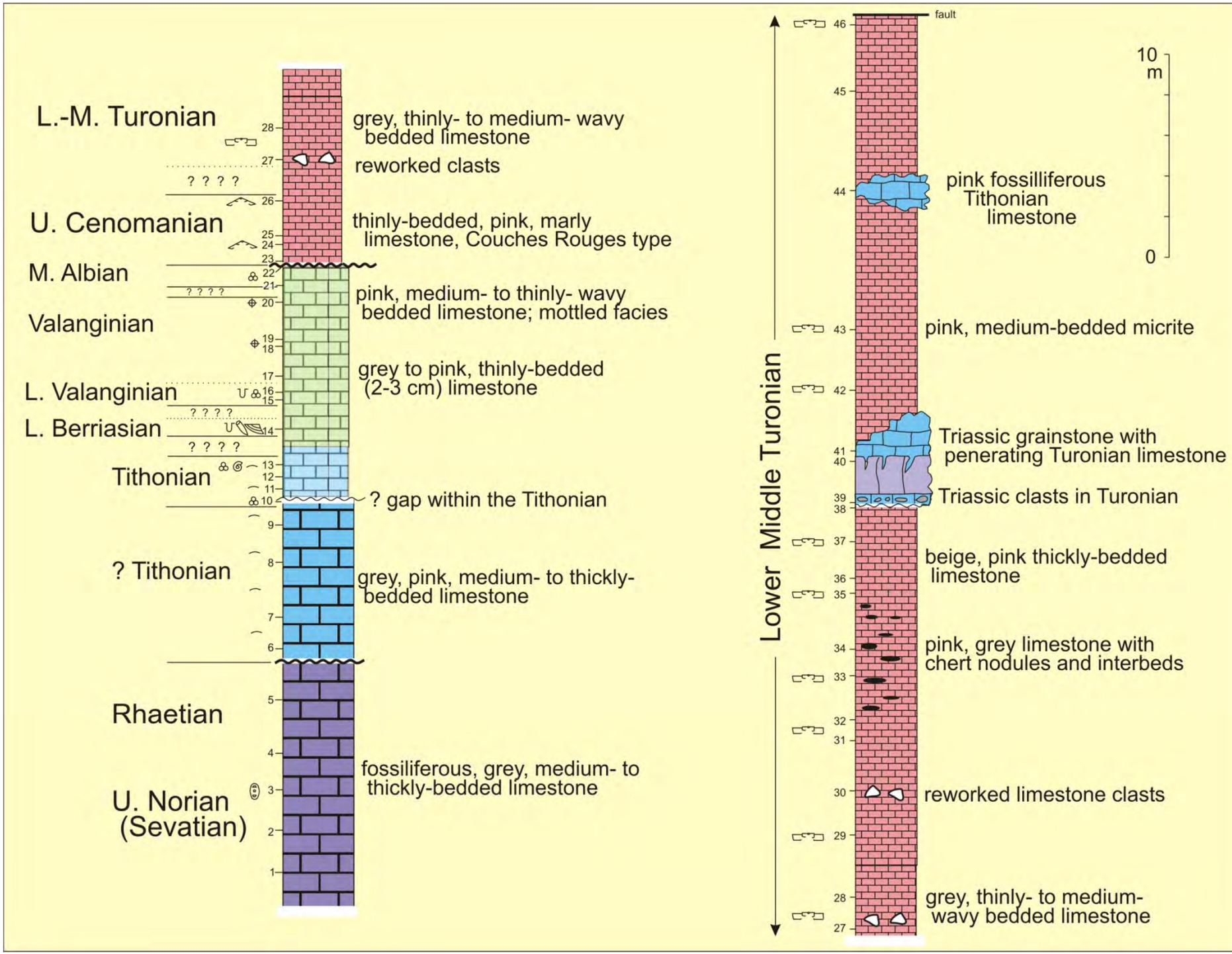

Orhanel
Balıkesir
13
Lesbos
Ayvalık
Sındırgı
11
Soma
12
9
10
Bergama
Simav
39°
Aegean
Akhisar
Sea
8
İzmir-Ankara suture
7
Gölmarmara
Manisa
Salihli
İzmir
Chios
Menderes Massif
Alaşehir
Urla
Seferihisar
Karaburun
Peninsula
Tire
38°
Samos
Kuşadası
Aydın

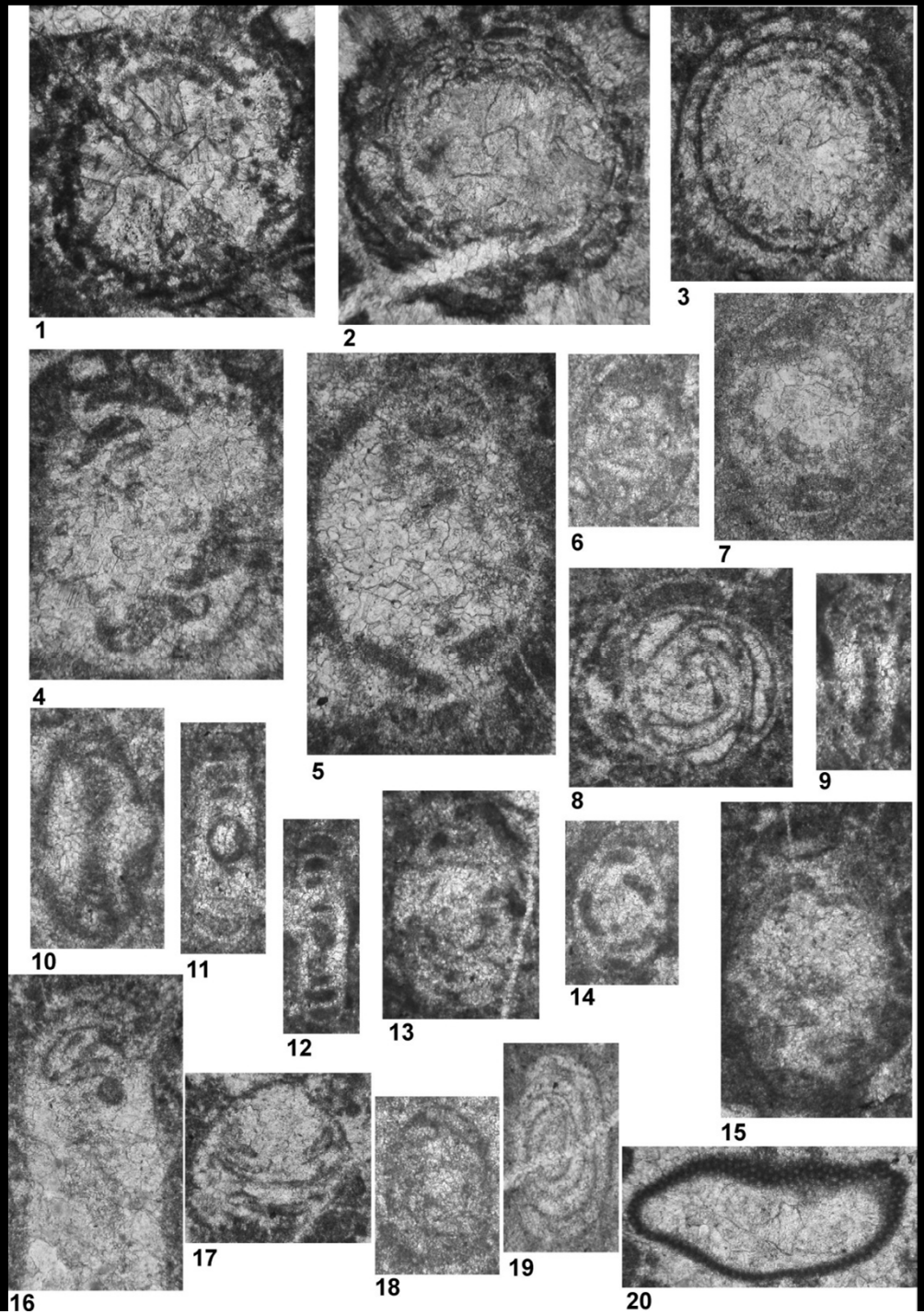

PLATFORM MARGIN TYPE BLOCKS IN THE BORNOVA FLYSCH ZONE
Keçiliköy 7
Sırtköy 8
Evkaftepe 9
Emiroğlu 10
Sarıkaya 11
Urbut 12
Gelenbe 13
40
60
80
100
120
140
160
180
200
220
EOCENE
PAL.
CRETACEOUS
JURASSIC
TRIASSIC
U
M
L
Bartonian
Lutetian
Ypresian
Thanetian
Selandian
Danian
Maastricht.
Campanian
Coniacian
Turonian
Cenom.
Albian
Aptian
Barremian
Hauterivian
Valanginian
Berriasian
Tithonian
Kimm.
Oxfordian
Callovian
Bathonian
Bajocian
Aalenian
Toarcian
Pliens.
Sinemurian
Hettangian
Rhaetian
Norian
Carnian
10 m
1 m
? ? ? ? ?
? ? ? ? ?
19 m


Shallow marine Upper Triassic limestone

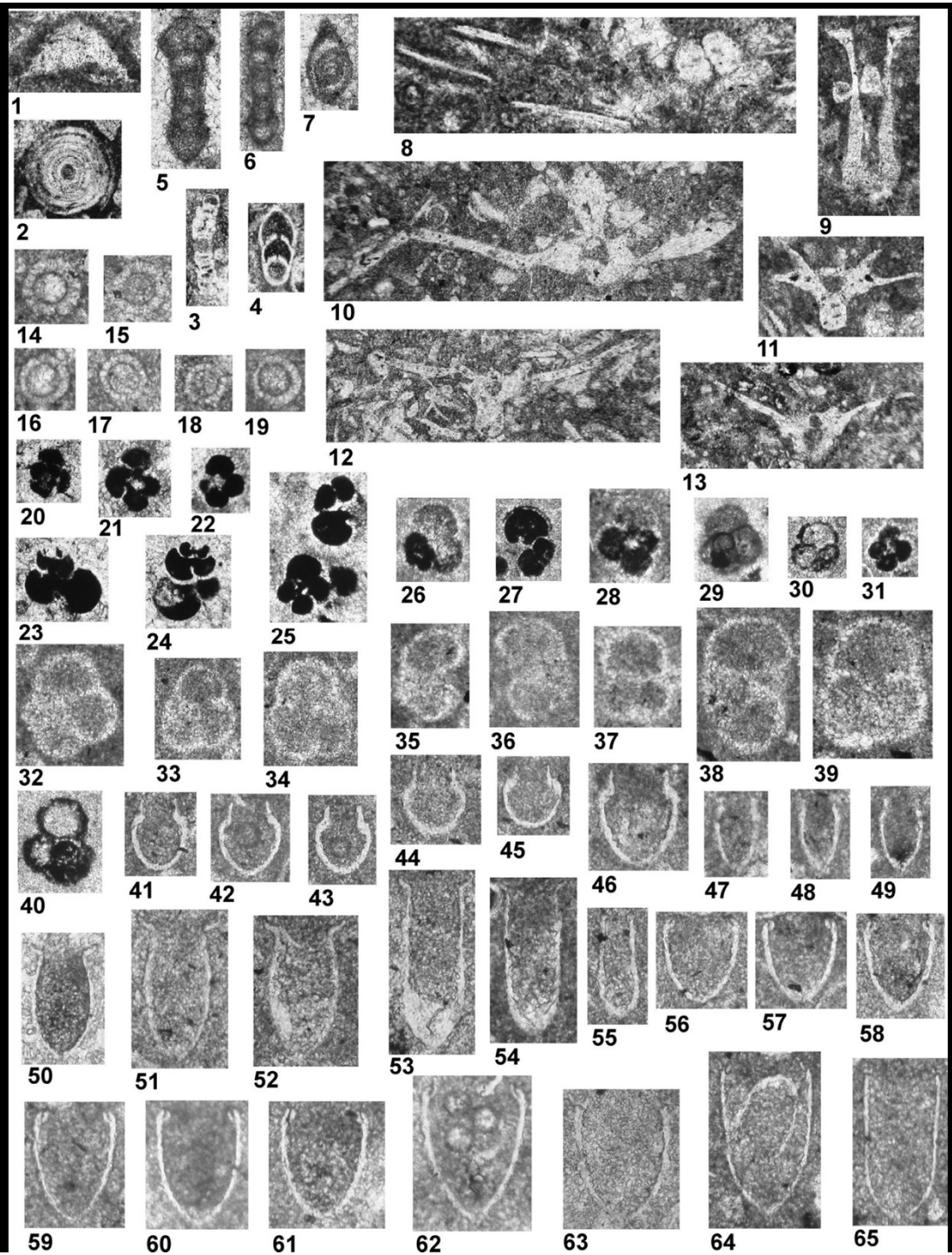

ALBIAN
TITHONIAN TO BERRIASIAN
SHALLOW MARINE NORIAN-RHAETIAN


700
700
600
Urbut section
700
Al
Urbut
(Yazören)
500
N
Quaternary
Al
alluvium
Miocene
volcanic rocks
Upper Cretaceous
limestone
Triassic-Cretaceou
0
1 km

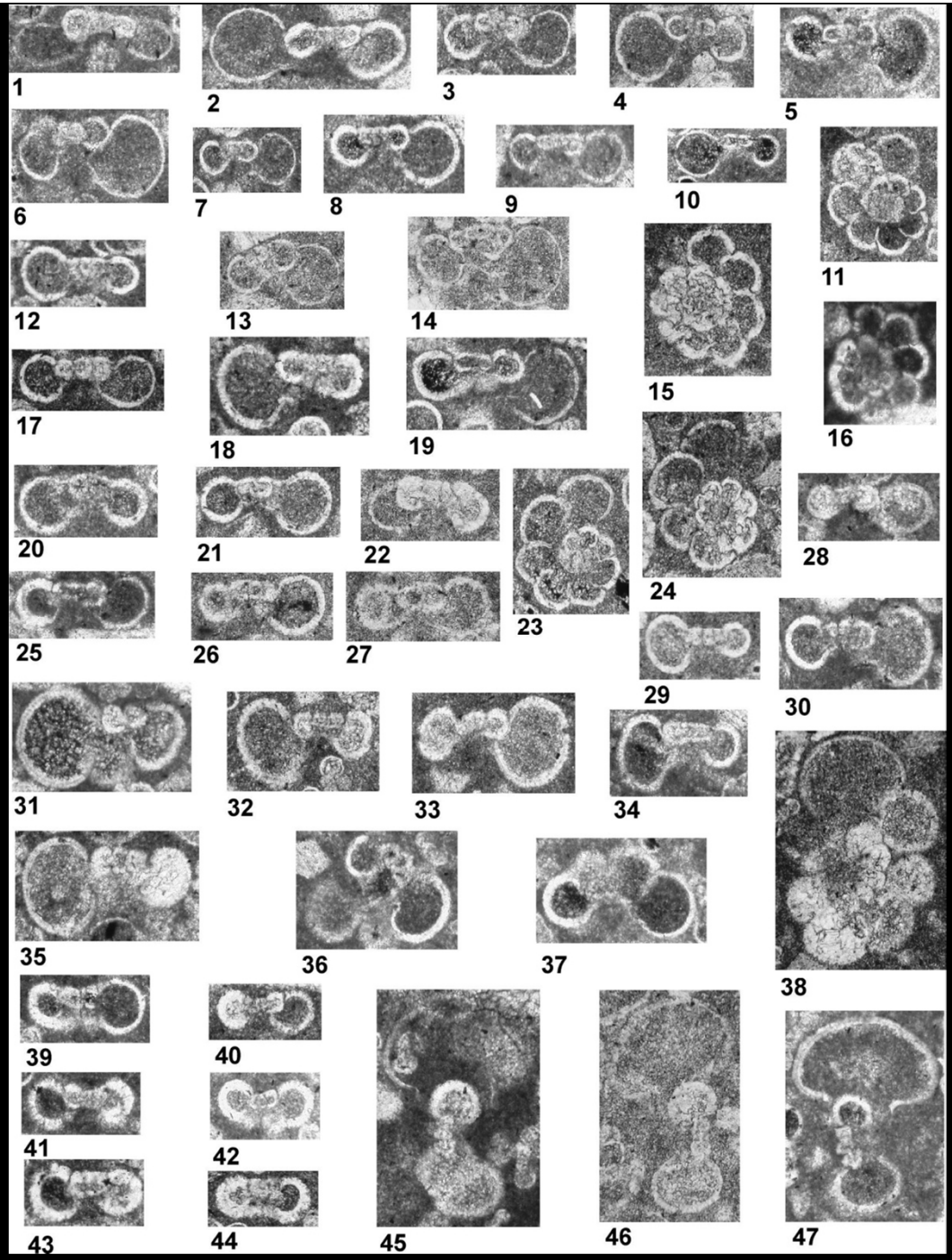

L.-M. Turonian
grey, thinly- to medium- wavy bedded limestone
reworked clasts
U. Cenomanian
thinly-bedded, pink, marly limestone, Couches Rouges type
M. Albian
Valanginian
pink, medium- to thinly- wavy bedded limestone; mottled facies
L. Valanginian
grey to pink, thinly-bedded (2-3 cm) limestone
L. Berriasian
Tithonian
? gap within the Tithonian
? Tithonian
grey, pink, medium- to thickly-bedded limestone
Rhaetian
fossiliferous, grey, medium- to thickly-bedded limestone
U. Norian (Sevatian)
fault
10 m
0
pink fossilliferous Tithonian limestone
pink, medium-bedded micrite
Triassic grainstone with penerating Turonian limestone
Triassic clasts in Turonian
beige, pink thickly-bedded limestone
pink, grey limestone with chert nodules and interbeds
reworked limestone clasts
grey, thinly- to medium-wavy bedded limestone
Lower Middle Turonian



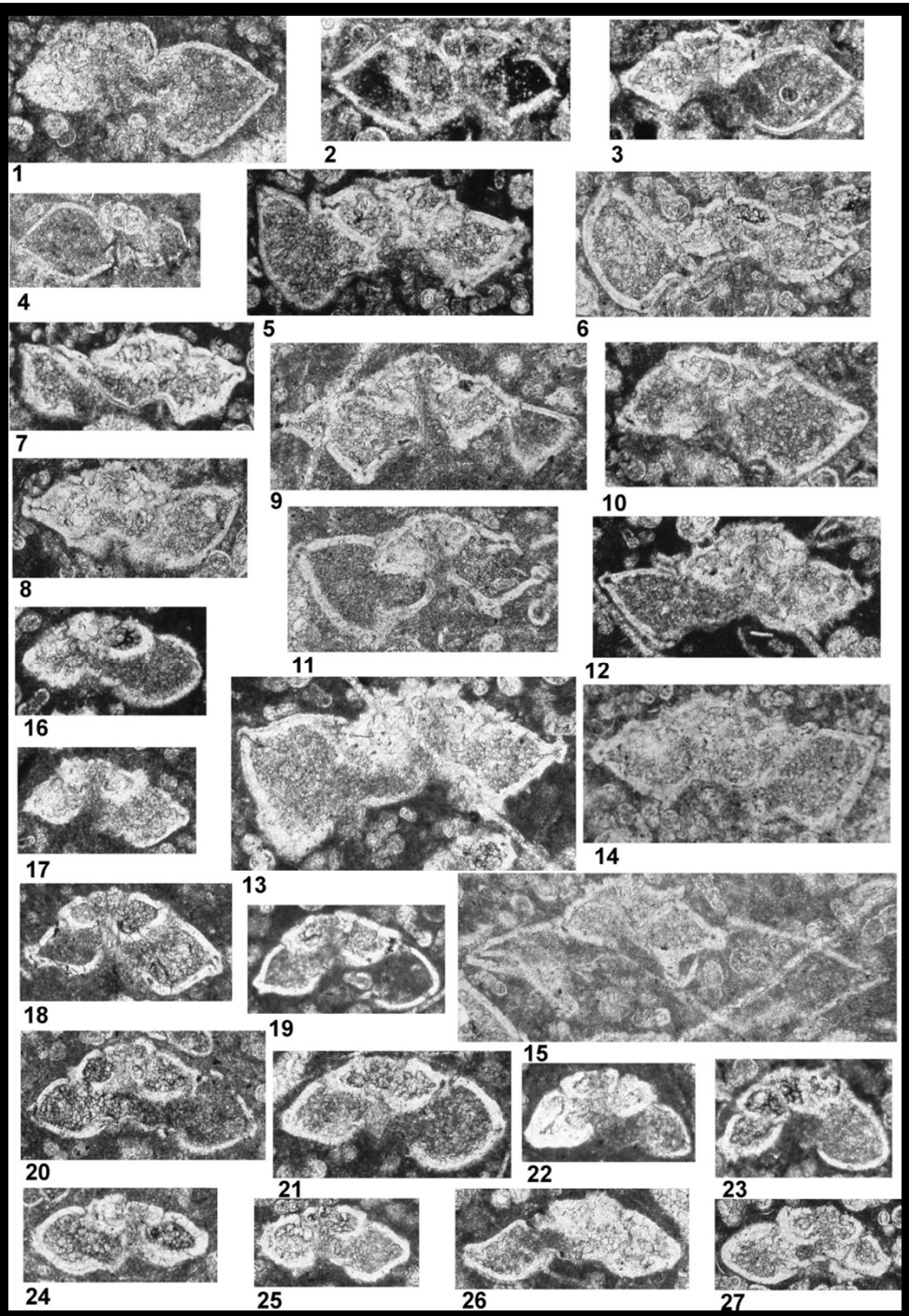
Upper Norian – Rhaetian



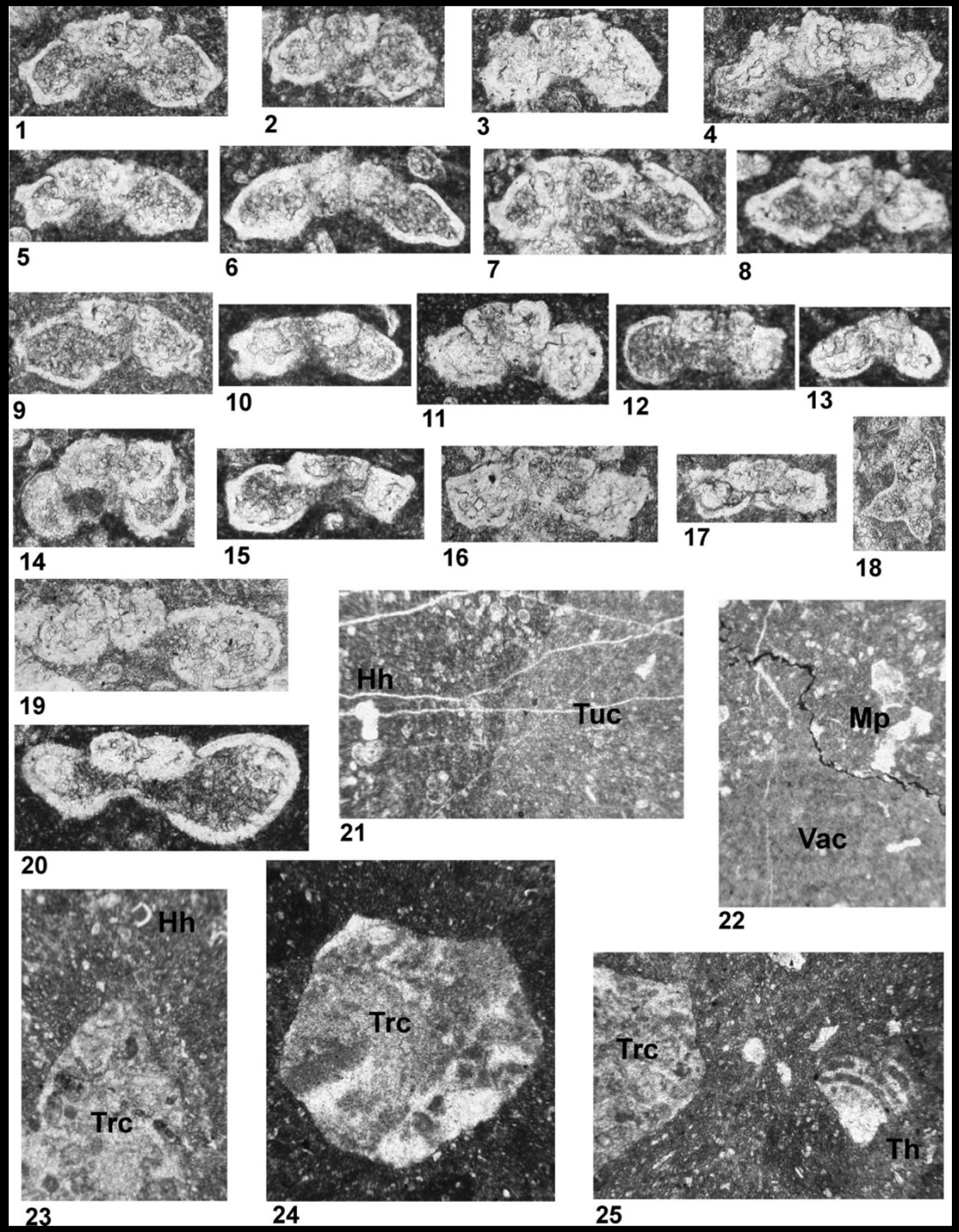
Tithonian – Valanginian



Middle Albian

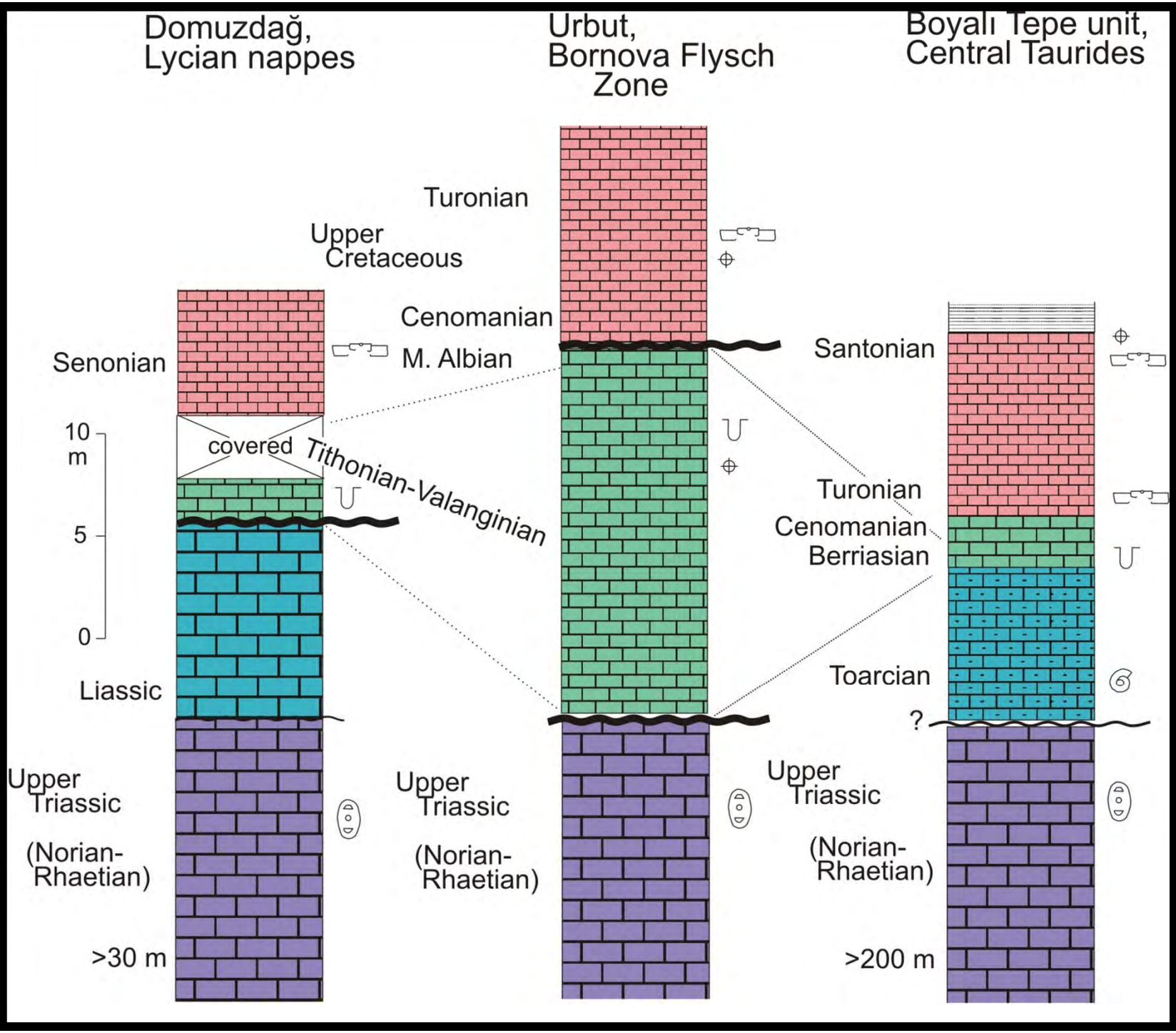


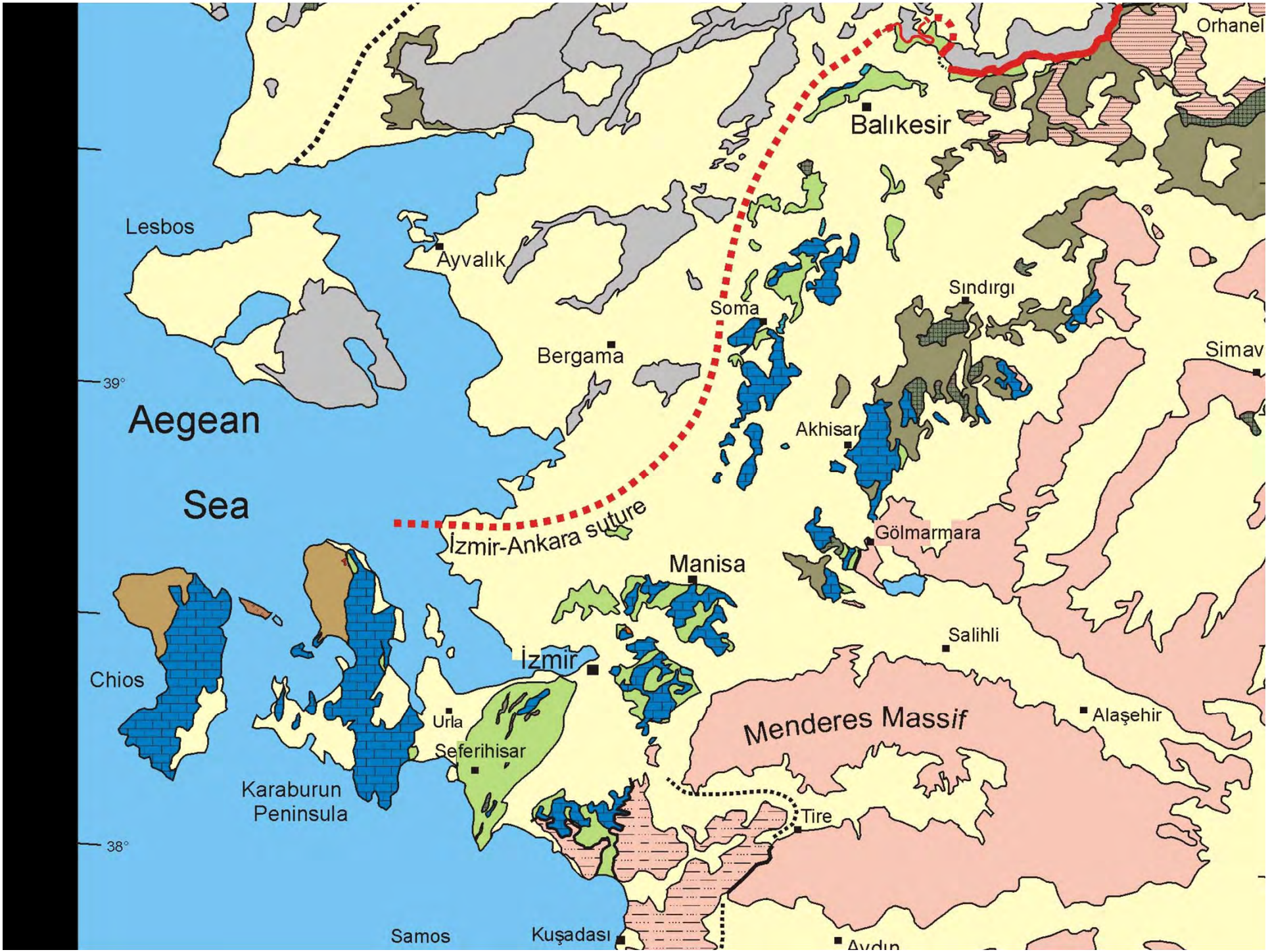
Upper Cenomanian



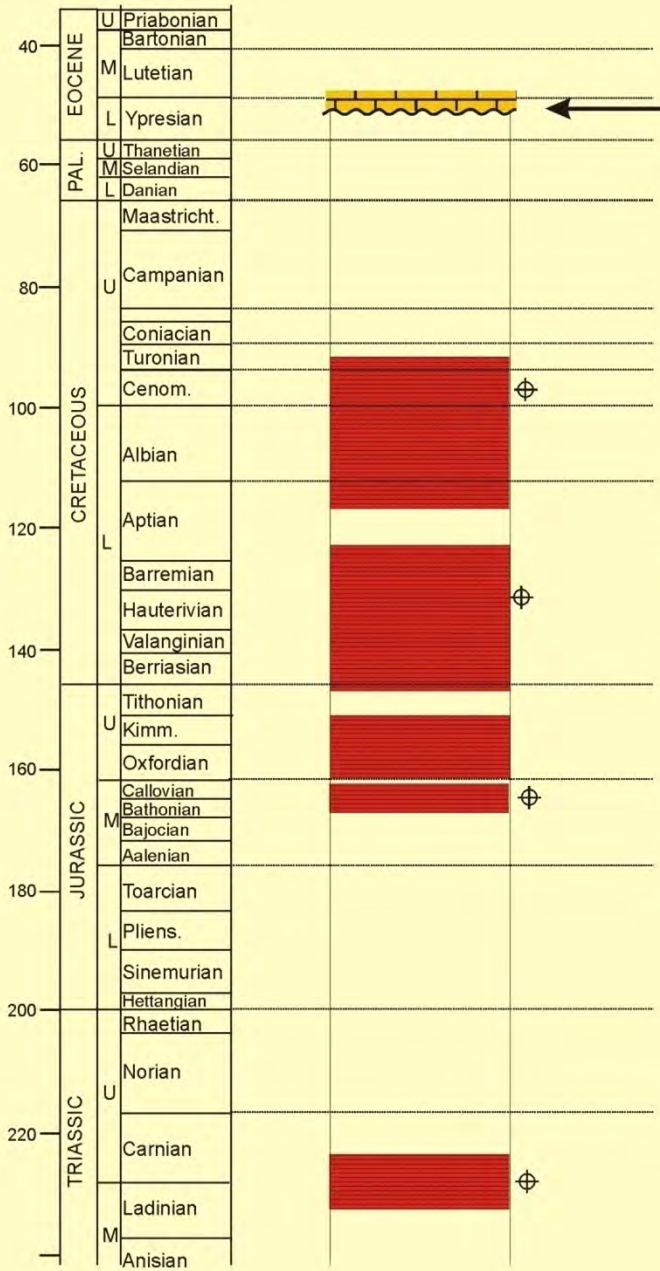
Lower-Middle Turonian


Bursa
Suture
40°
Vardar Zone
Sakarya Zone
Ankara
Cretaceous blueschists
İzmir -
Afyon Zone
Lesbos
Bornova Flysch zone
Northern
submassif
Menderes
Pelagonian zone
İzmir
Chios
Central
submassif
Massif
38°
Samos
Domuzdağ
unit
Southern
submassif
Cycladic metamorphic
complex
Lycian
nappes
Rhodes
36°
AEGEAN SEA
0
100
200 km
Crete
24°
26°
28°


Domuzdağ,
Lycian nappes
Urbut,
Bornova Flysch
Zone
Boyalı Tepe unit,
Central Taurides
Turonian
Upper
Cretaceous
Cenomanian
M. Albian
Senonian
10
m
covered
Tithonian-Valanginian
5
0
Liassic
Upper
Triassic
(Norian-
Rhaetian)
>30 m
Upper
Triassic
(Norian-
Rhaetian)
Santonian
Turonian
Cenomanian
Berriasian
Toarcian
?
Upper
Triassic
(Norian-
Rhaetian)
>200 m

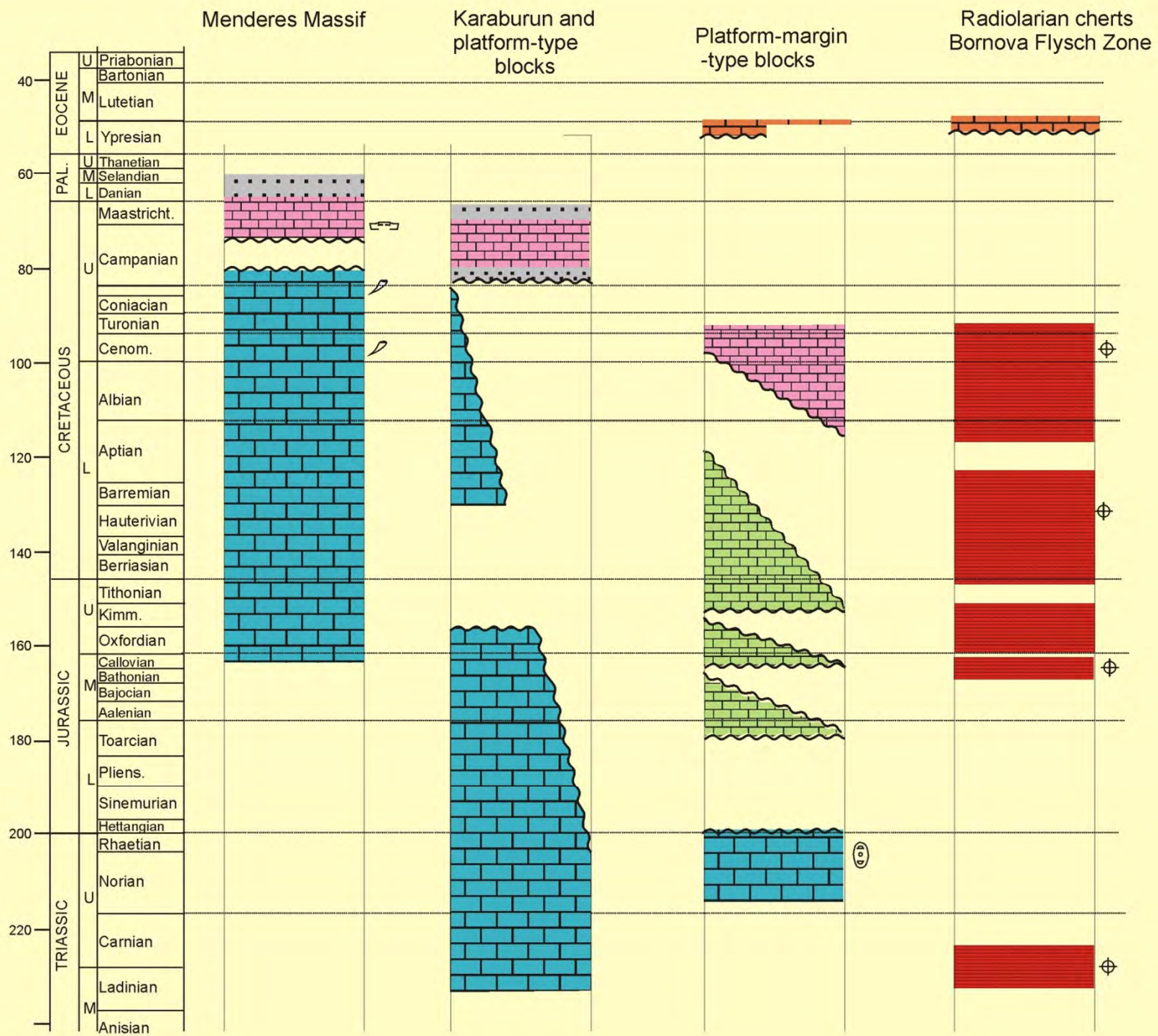

Orhanel
Balıkesir
Lesbos
Ayvalık
Soma
Sındırgı
Bergama
Simav
39°
Aegean
Sea
Akhisar
İzmir-Ankara suture
Gölmarmara
Manisa
Salihli
İzmir
Chios
Urla
Menderes Massif
Alaşehir
Seferihisar
Karaburun
Peninsula
Tire
38°
Samos
Kuşadası
Aydın

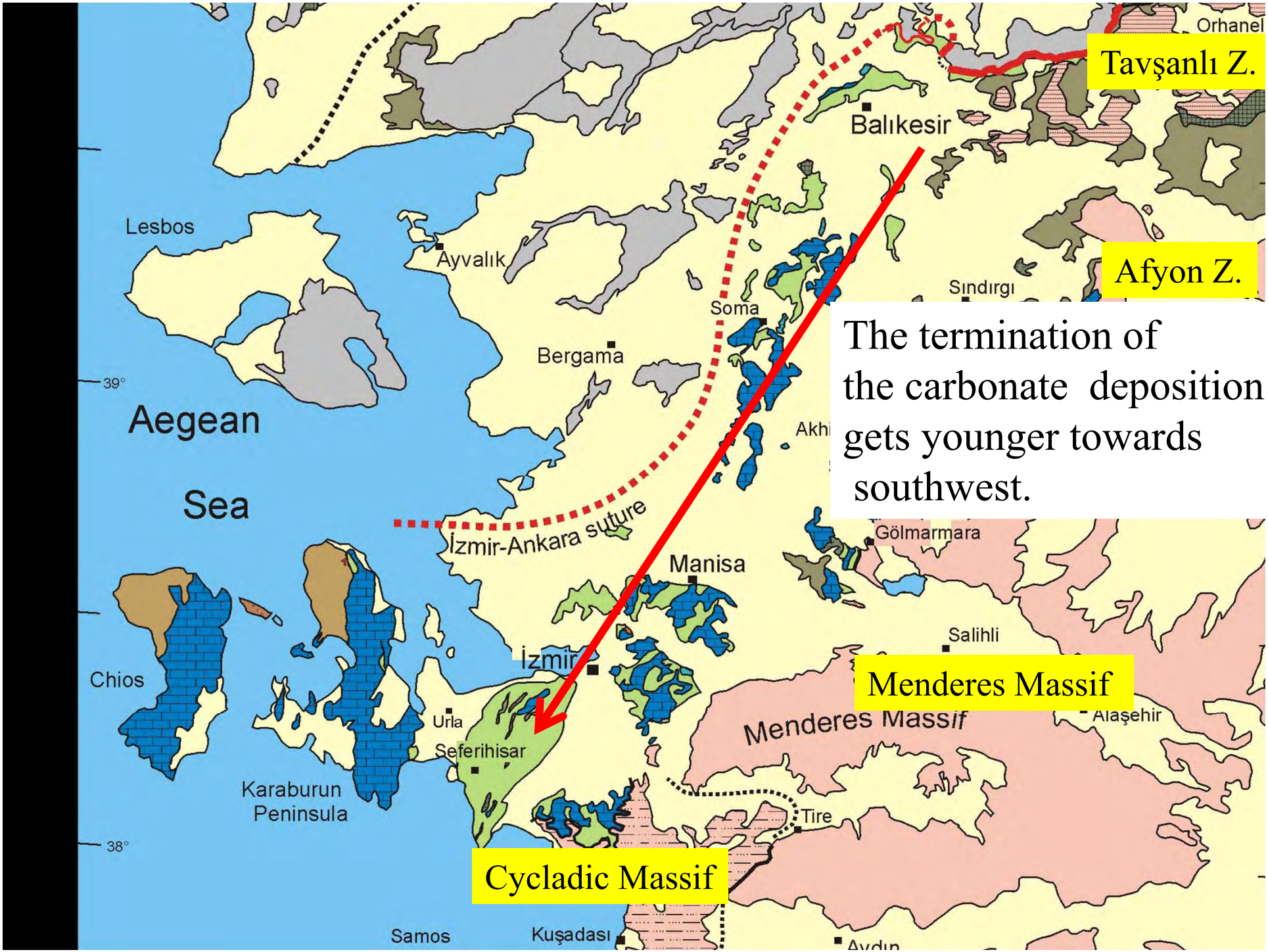

Ophiolitic melange, Balıkesir

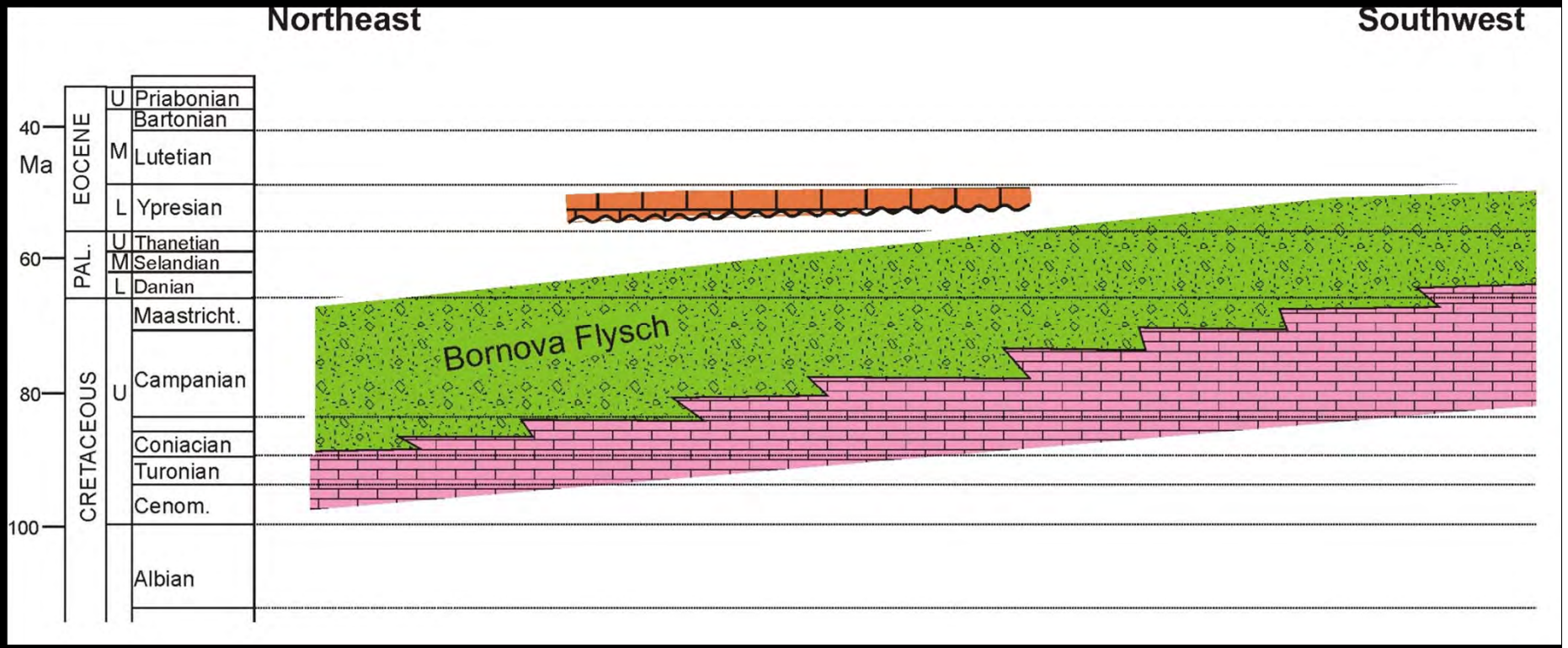


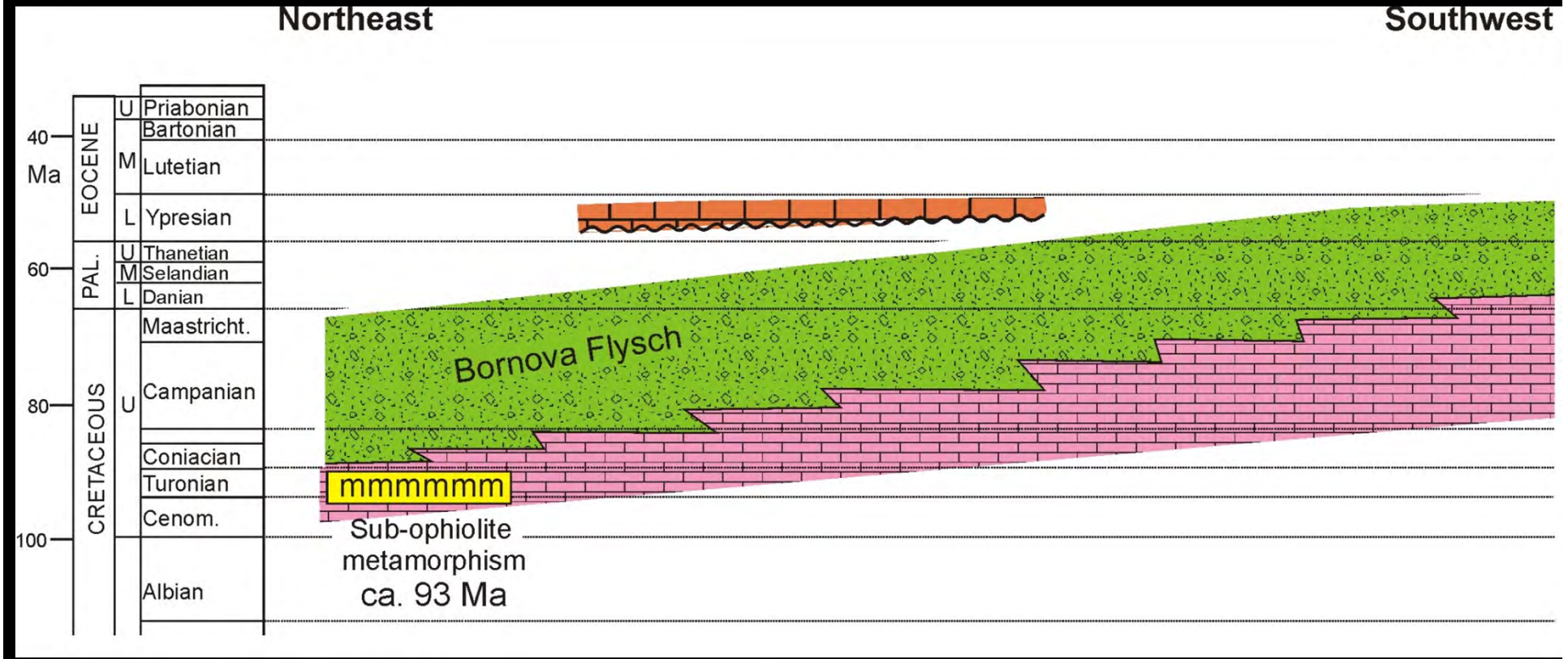
Unconformable Eocene cover

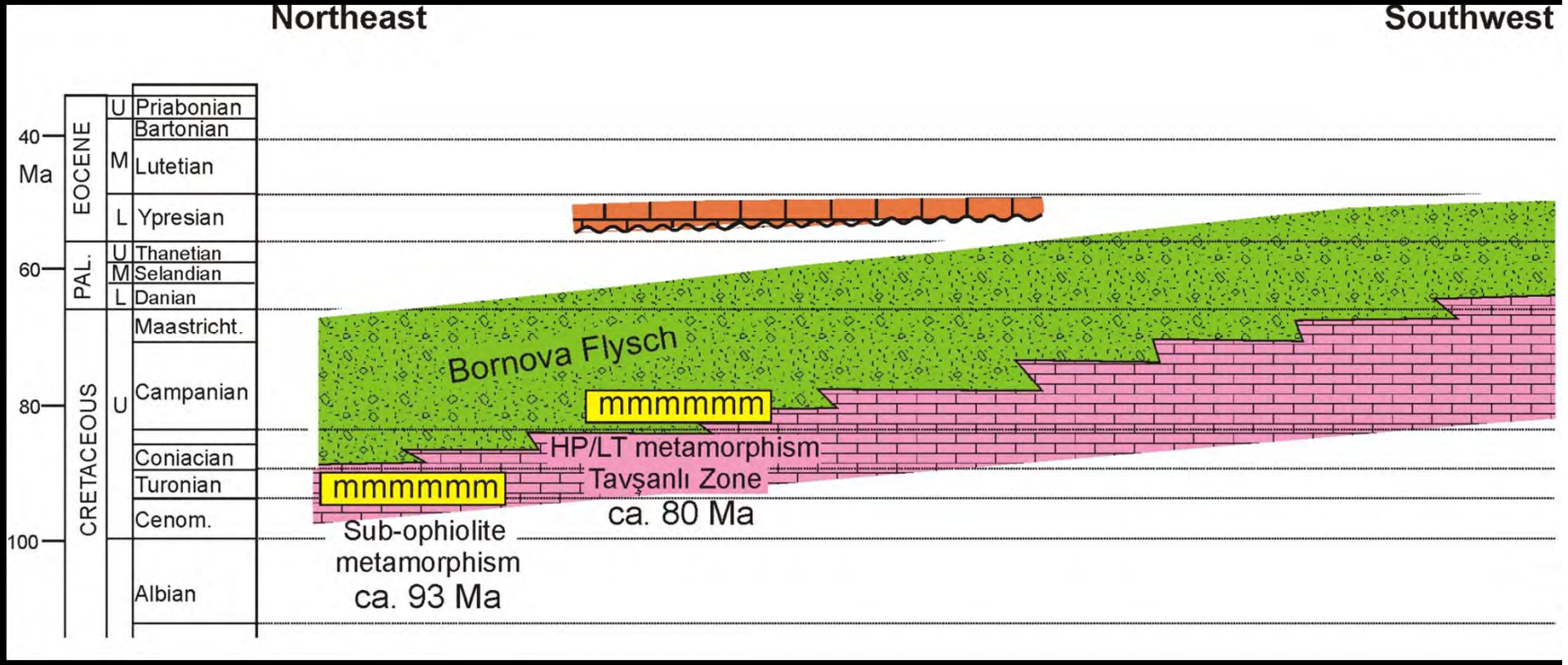
Radiolaria ages from the chert blocks in the Bornova Flysch Zone (Tekin & Göncüoğlu, 2007, 2009)

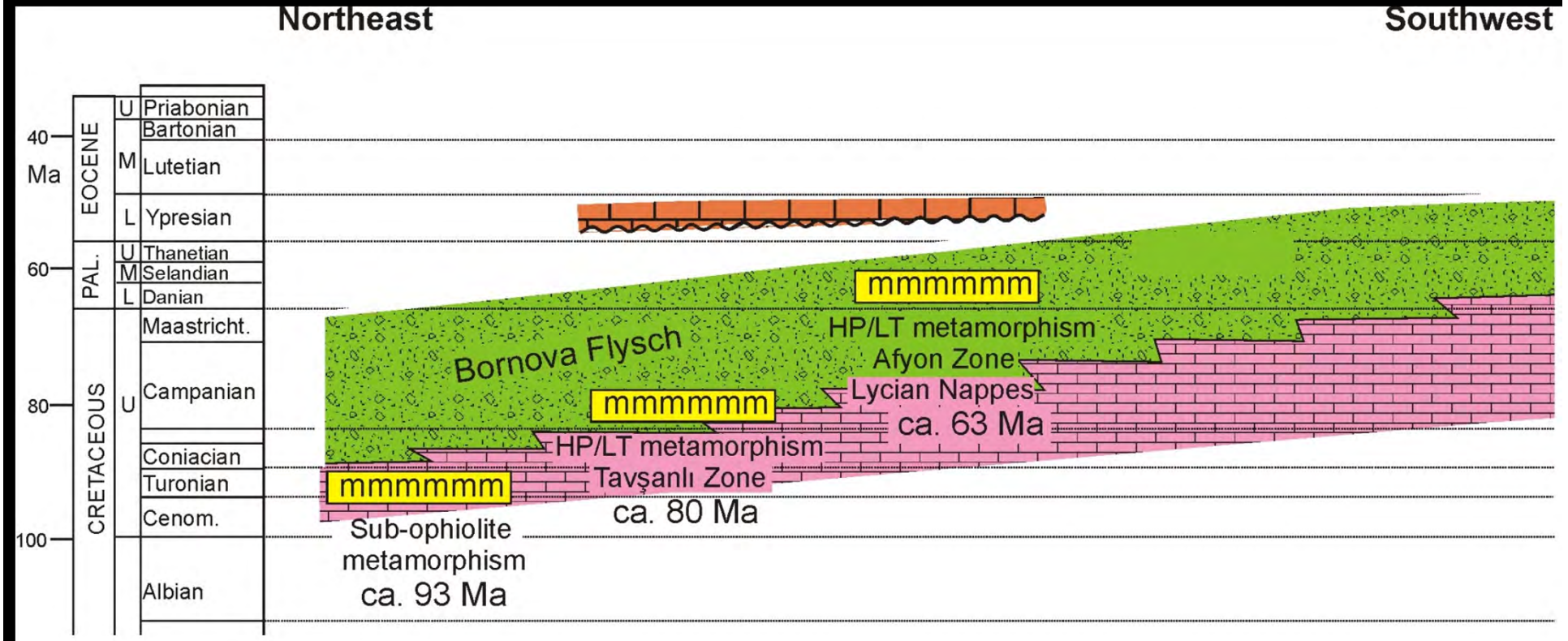

Menderes Massif
Karaburun and platform-type blocks
Platform-margin -type blocks
Radiolarian cherts Bornova Flysch Zone
40
60
80
100
120
140
160
180
200
220
EOCENE
PAL.
CRETACEOUS
JURASSIC
TRIASSIC
U
M
L
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Selandian
Danian
Maastricht.
Campanian
Coniacian
Turonian
Cenom.
Albian
Aptian
Barremian
Hauterivian
Valanginian
Berriasian
Tithonian
Kimm.
Oxfordian
Callovian
Bathonian
Bajocian
Aalenian
Toarcian
Pliens.
Sinemurian
Hettangian
Rhaetian
Norian
Carnian
Ladinian
Anisian

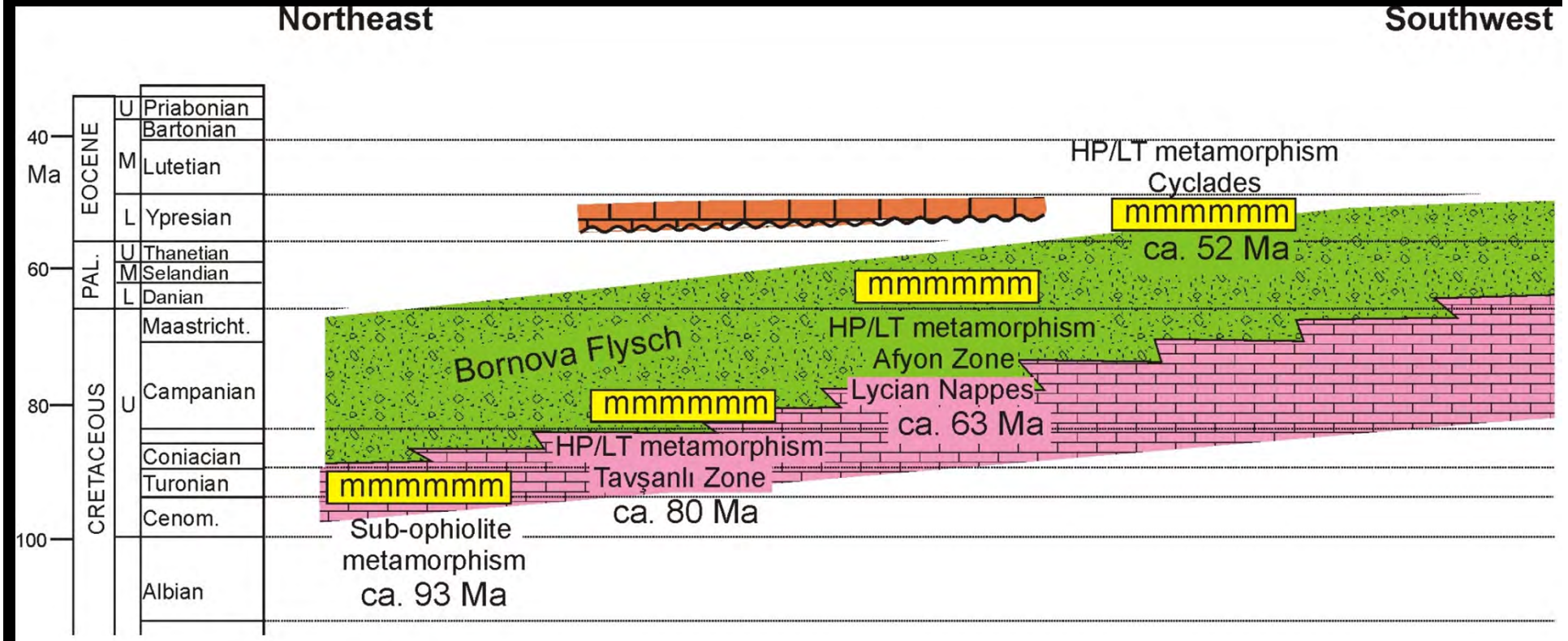

Tavşanlı Z.
Afyon Z.
The termination of the carbonate deposition gets younger towards southwest.
Menderes Massif
Cycladic Massif
Aegean
Sea
İzmir-Ankara suture
Balıkesir
Lesbos
Ayvalık
Soma
Bergama
Sındırgı
Manisa
İzmir
Gölmarmara
Salihli
Alaşehir
Chios
Urla
Seferihisar
Karaburun Peninsula
Tire
Samos
Kuşadası
Aydın
39°
38°

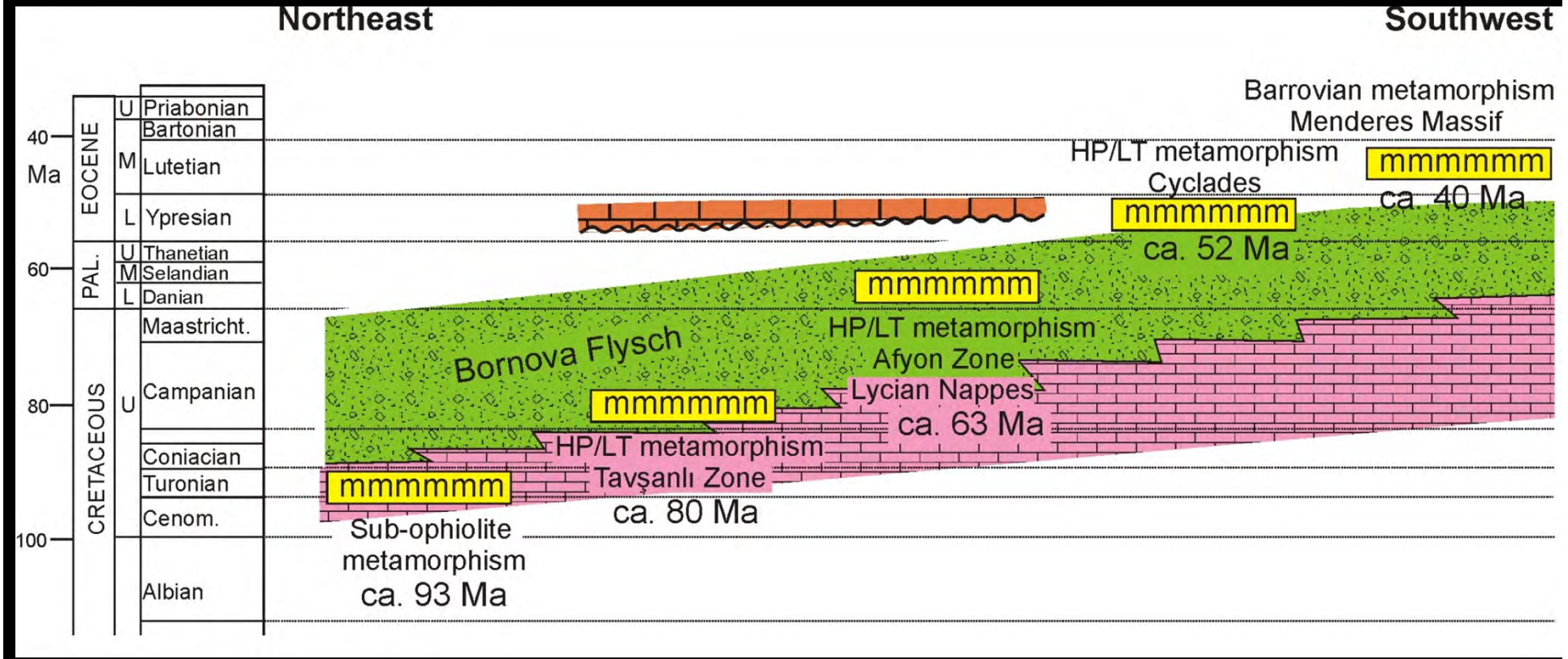

Northeast
Southwest
40
Ma
60
80
100
EOCENE
PAL.
CRETACEOUS
U
M
L
U
M
L
U
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Selandian
Danian
Maastricht.
Campanian
Coniacian
Turonian
Cenom.
Albian
Bornova Flysch

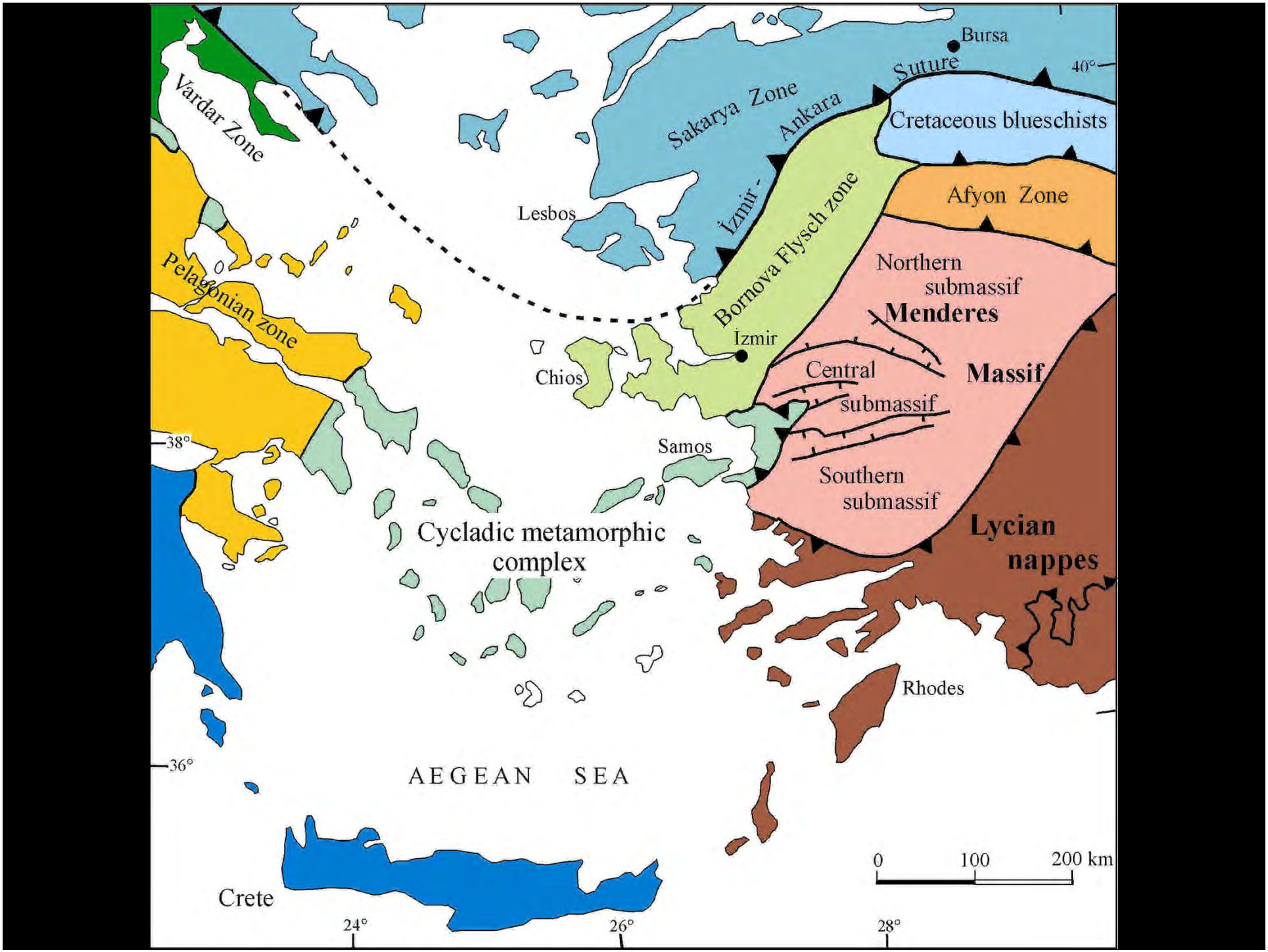

Northeast
Southwest
Ma
40
60
80
100
EOCENE
PAL.
CRETACEOUS
U
M
L
U
M
L
U
C
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Selandian
Danian
Maastricht.
Campanian
Coniacian
Turonian
Cenom.
Albian
Bornova Flysch
mmmmmm
Sub-ophiolite
metamorphism
ca. 93 Ma

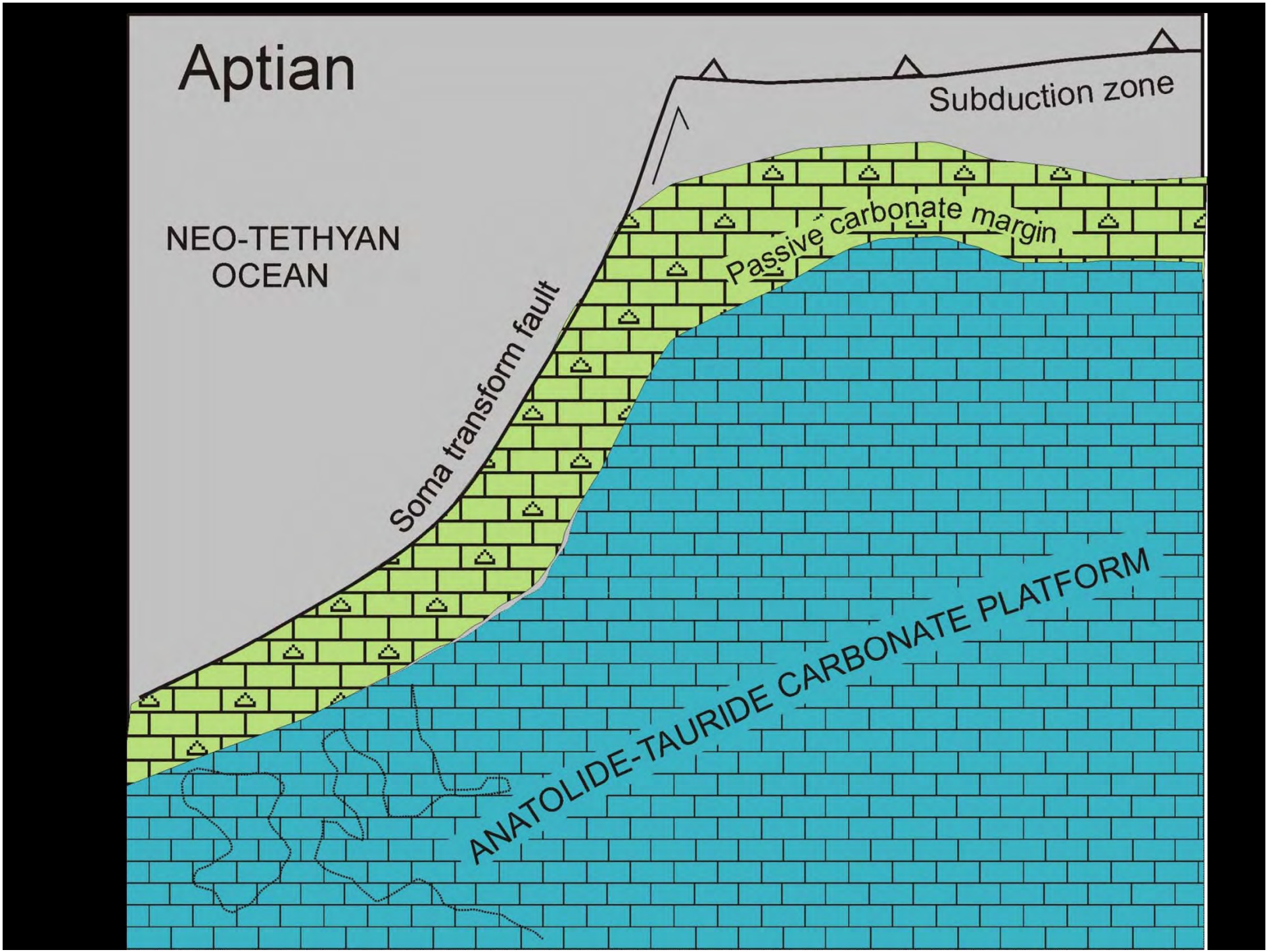

Northeast
Southwest
Ma
40
60
80
100
EOCENE
PAL.
CRETACEOUS
U
M
L
U
M
L
U
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Selandian
Danian
Maastricht.
Campanian
Coniacian
Turonian
Cenom.
Albian
Bornova Flysch
mmmmmm
HP/LT metamorphism
Tavşanlı Zone
ca. 80 Ma
mmmmmm
Sub-ophiolite
metamorphism
ca. 93 Ma

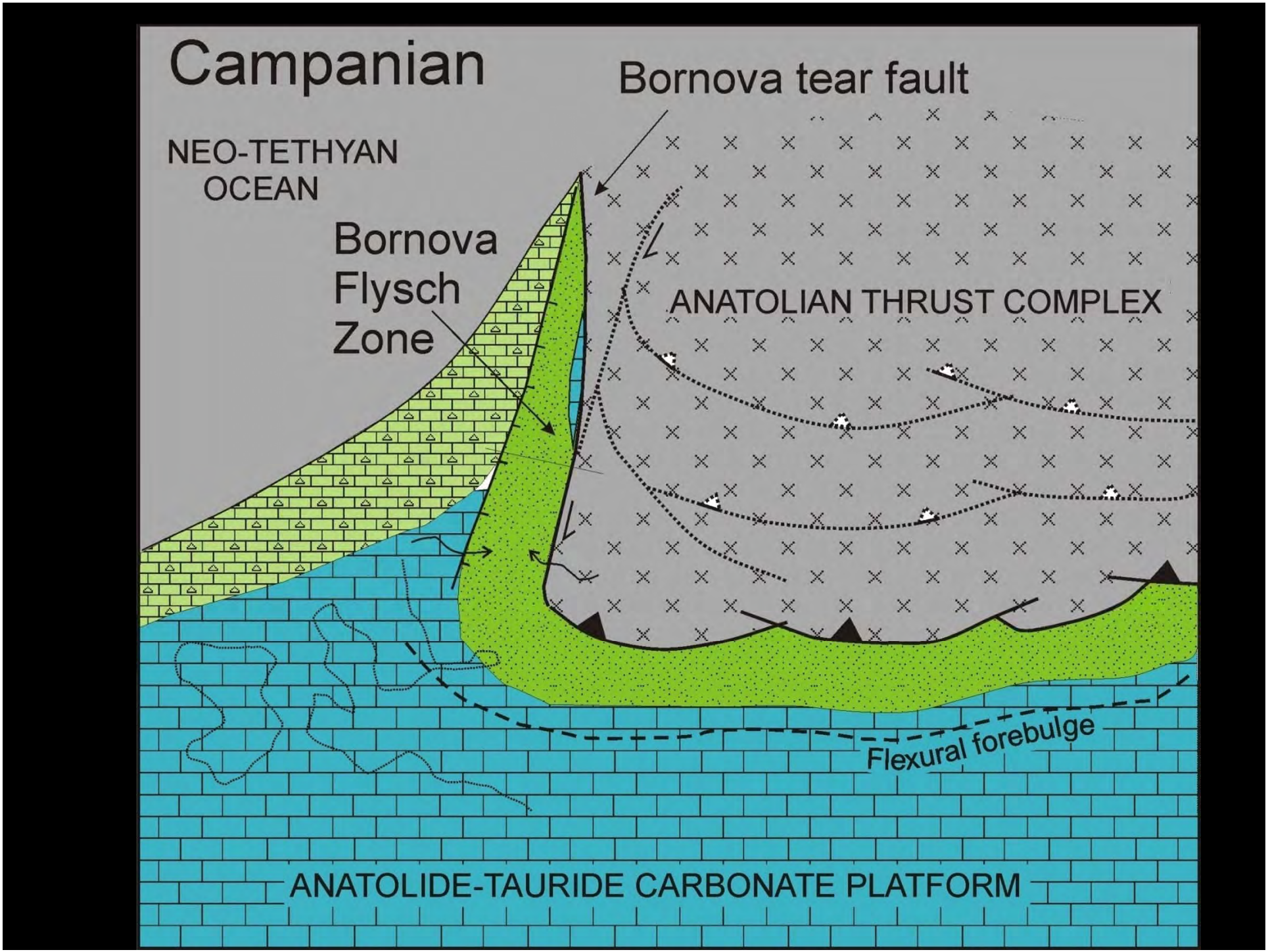

Northeast
Southwest
40
Ma
60
80
100
EOCENE
PAL.
CRETACEOUS
U
M
L
U
M
L
U
C
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Selandian
Danian
Maastricht.
Campanian
Coniacian
Turonian
Cenom.
Albian
mmmmmm
Bornova Flysch
HP/LT metamorphism
Afyon Zone
Lycian Nappes
ca. 63 Ma
mmmmmm
HP/LT metamorphism
Tavşanlı Zone
ca. 80 Ma
mmmmmm
Sub-ophiolite
metamorphism
ca. 93 Ma

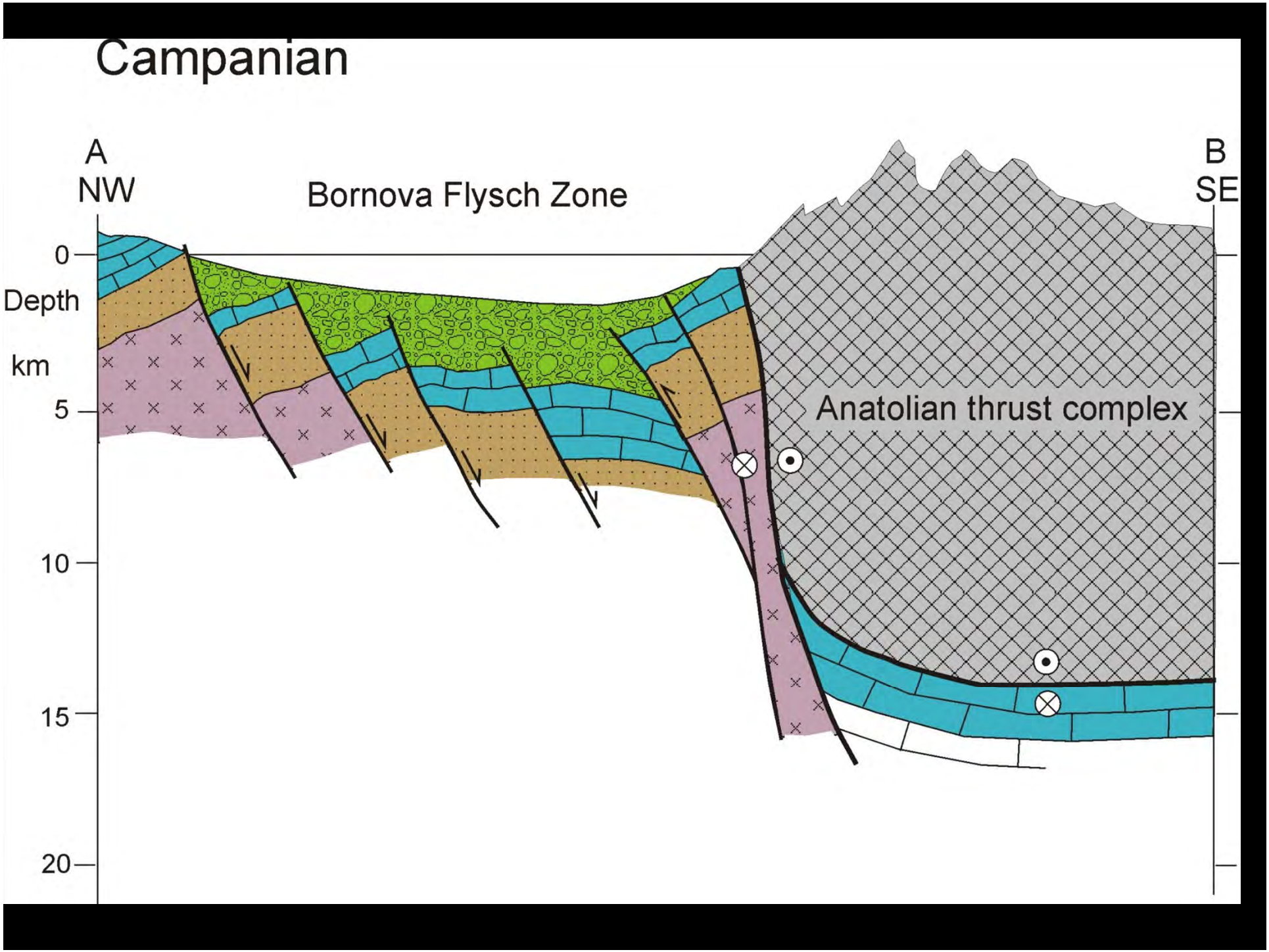

Northeast
Southwest
40
Ma
60
80
100
EOCENE
PAL.
CRETACEOUS
U
M
L
U
M
L
U
C
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Selandian
Danian
Maastricht.
Campanian
Coniacian
Turonian
Cenom.
Albian
HP/LT metamorphism
Cyclades
mmmmmm
ca. 52 Ma
mmmmmm
Bornova Flysch
HP/LT metamorphism
Afyon Zone
Lycian Nappes
mmmmmm
ca. 63 Ma
HP/LT metamorphism
Tavşanlı Zone
mmmmmm
ca. 80 Ma
Sub-ophiolite
metamorphism
ca. 93 Ma

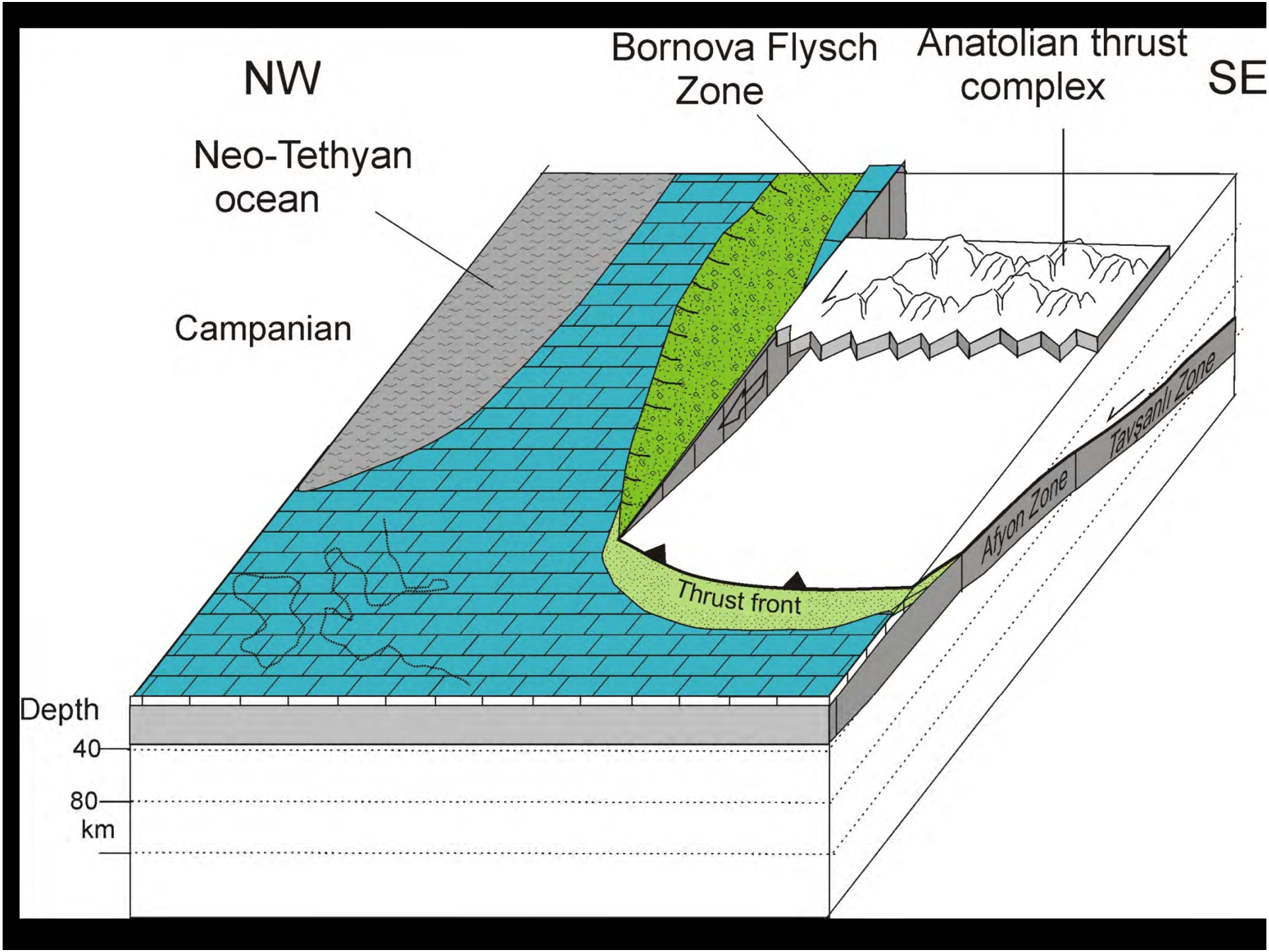

Northeast
Southwest
Ma
40
60
80
100
EOCENE
PAL.
CRETACEOUS
U
M
L
U
M
L
U
Priabonian
Bartonian
Lutetian
Ypresian
Thanetian
Selandian
Danian
Maastricht.
Campanian
Coniacian
Turonian
Cenom.
Albian
Barrovian metamorphism
Menderes Massif
HP/LT metamorphism
Cyclades
mmmmmm
ca. 40 Ma
mmmmmm
ca. 52 Ma
mmmmmm
Bornova Flysch
HP/LT metamorphism
Afyon Zone
Lycian Nappes
mmmmmm
ca. 63 Ma
HP/LT metamorphism
Tavşanlı Zone
mmmmmm
ca. 80 Ma
Sub-ophiolite
metamorphism
ca. 93 Ma


Bursa
40°
Suture
Vardar Zone
Sakarya Zone
Ankara
Cretaceous blueschists
İzmir -
Afyon Zone
Lesbos
Bornova Flysch zone
Northern
submassif
Menderes
Massif
Pelagonian zone
İzmir
Chios
Central
submassif
38°
Samos
Southern
submassif
Cycladic metamorphic
complex
Lycian
nappes
Rhodes
36°
AEGEAN SEA
0
100
200 km
Crete
24°
26°
28°


Aptian
Subduction zone
NEO-TETHYAN
OCEAN
Passive carbonate margin
Soma transform fault
ANATOLIDE-TAURIDE CARBONATE PLATFORM


Campanian
Bornova tear fault
NEO-TETHYAN
OCEAN
Bornova
Flysch
Zone
ANATOLIAN THRUST COMPLEX
Flexural forebulge
ANATOLIDE-TAURIDE CARBONATE PLATFORM


Campanian
A
NW
Bornova Flysch Zone
B
SE
0
Depth
km
5
10
15
20
Anatolian thrust complex


NW
Bornova Flysch Zone
Anatolian thrust complex
SE
Neo-Tethyan ocean
Campanian
Thrust front
Afyon Zone
Tavşanlı Zone
Depth
40
80
km

Conclusions

1. The Bornova Flysch Zone (BFZ) is a regional olistostrome-melange belt of sedimentary and tectonic origin.

2. The blocks in the BFZ are mainly of Mesozoic carbonate and ophiolite, which lie in a latest Cretaceous-Paleocene clastic matrix.
The blocks are of two types:

a) Carbonate platform type

b) Carbonate platform margin type

3. The BFZ was formed and deformed in a dynamic basin in a lithospheric scale shear zone.