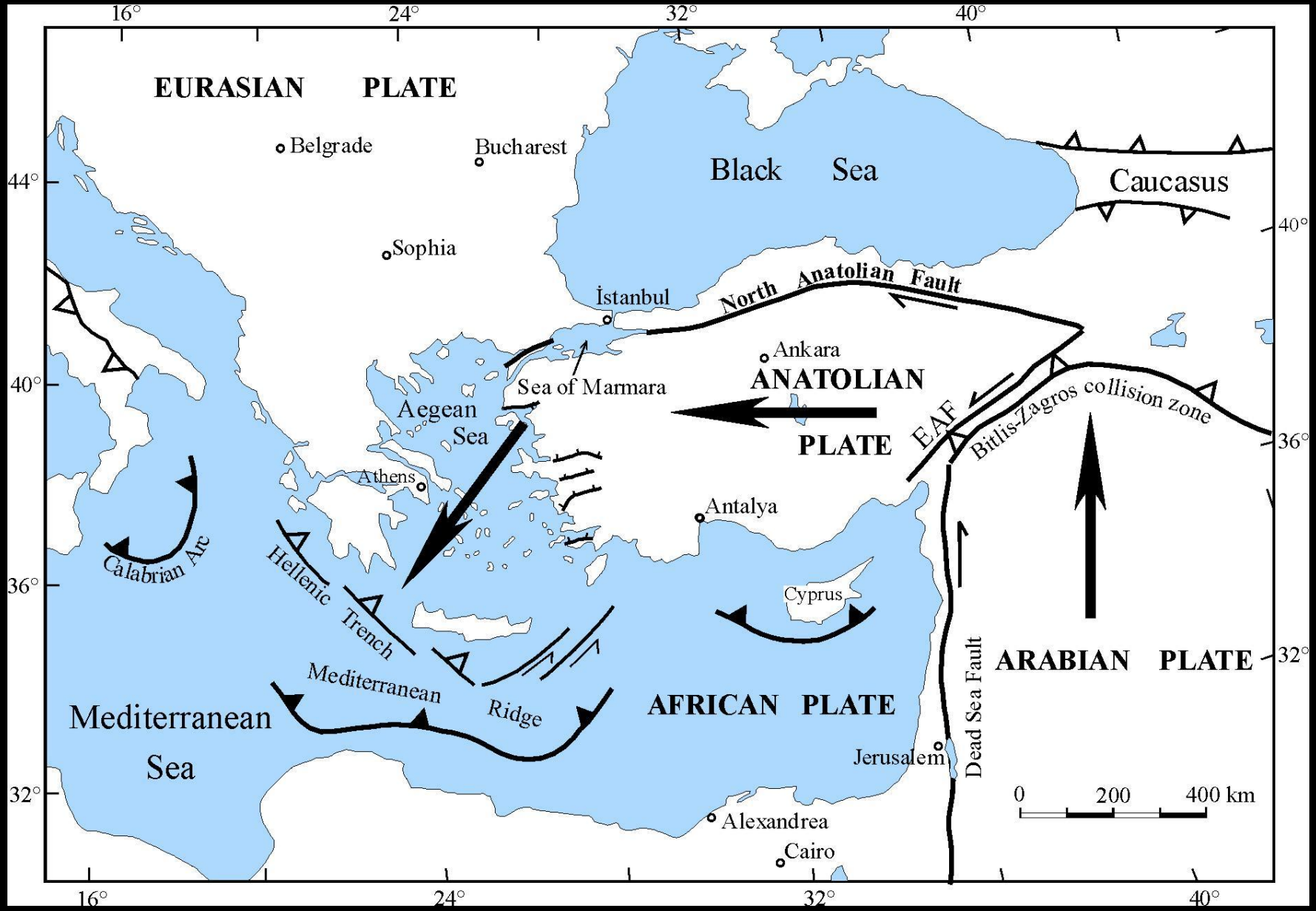
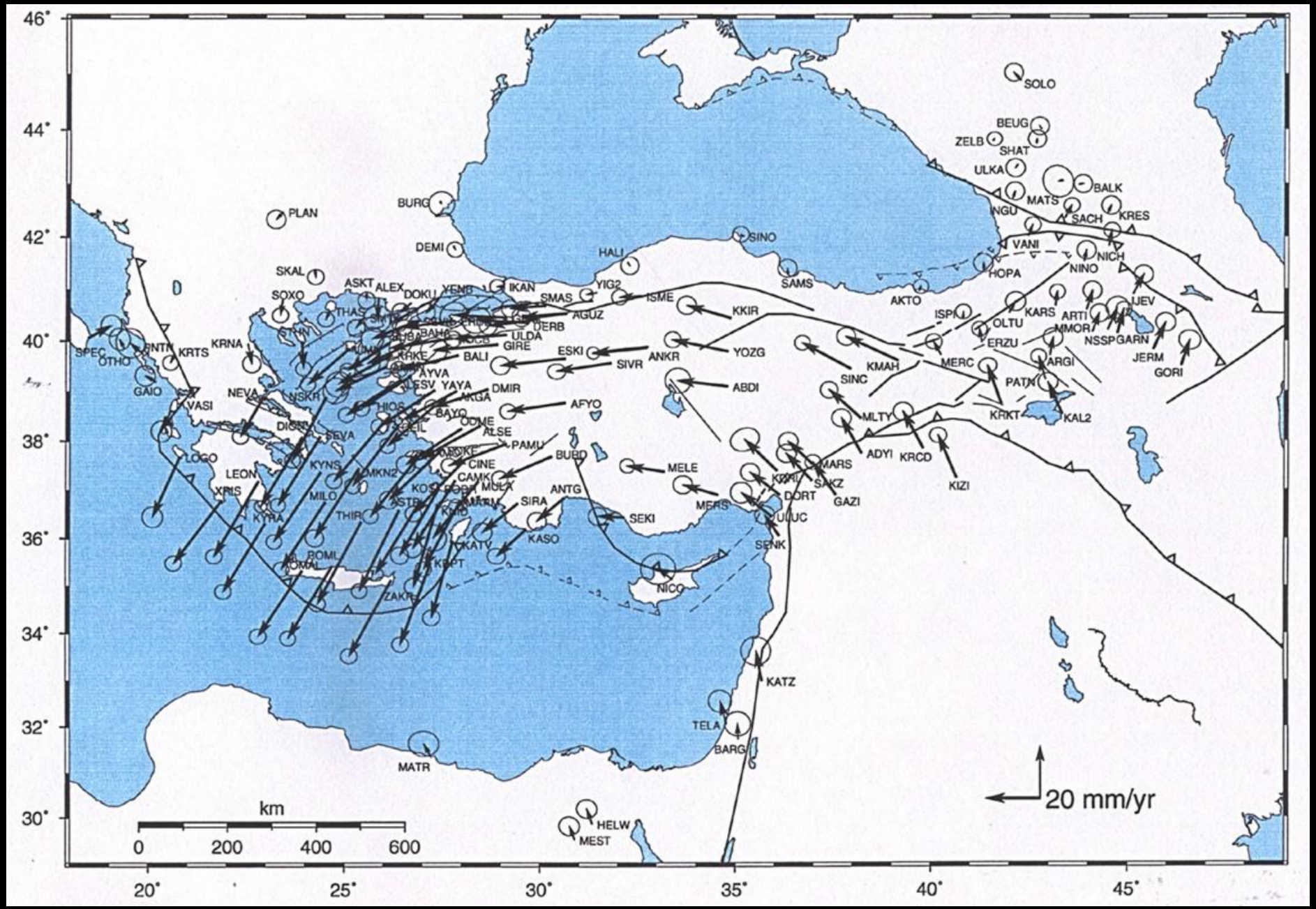
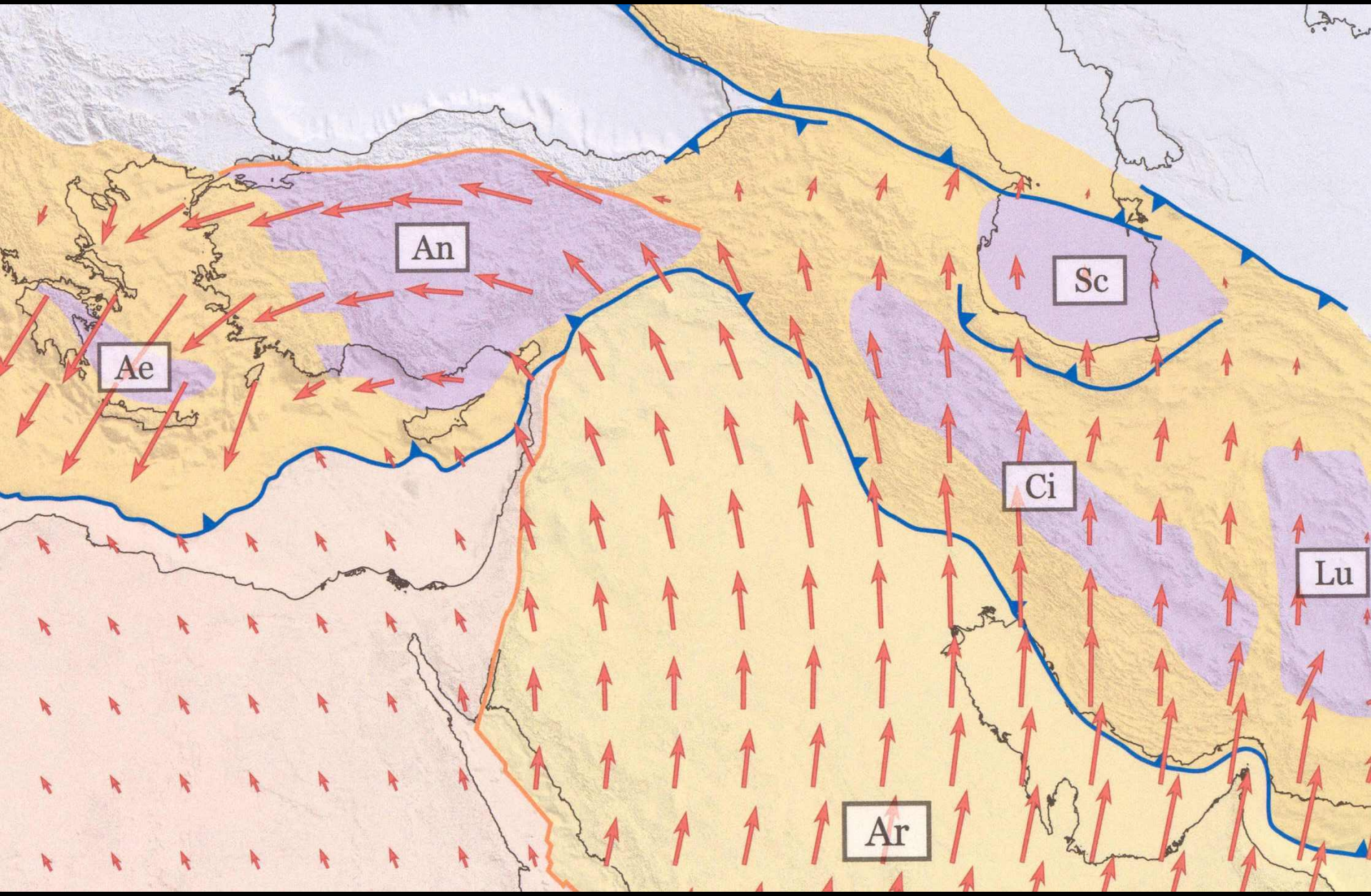
Ege’de genişleme ne zaman ve niçin başladı – Kazdağ’dan veriler

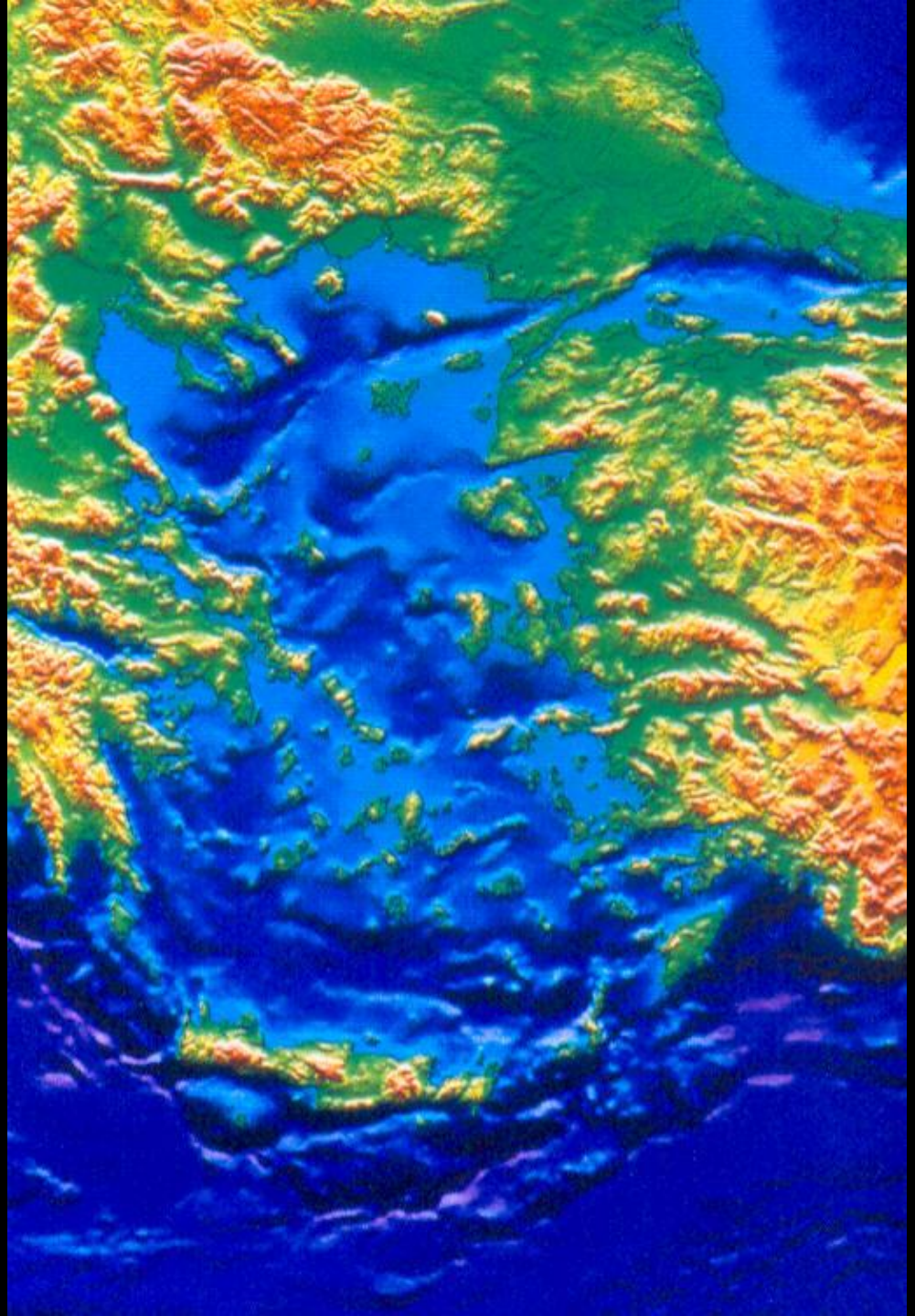
Aral Okay

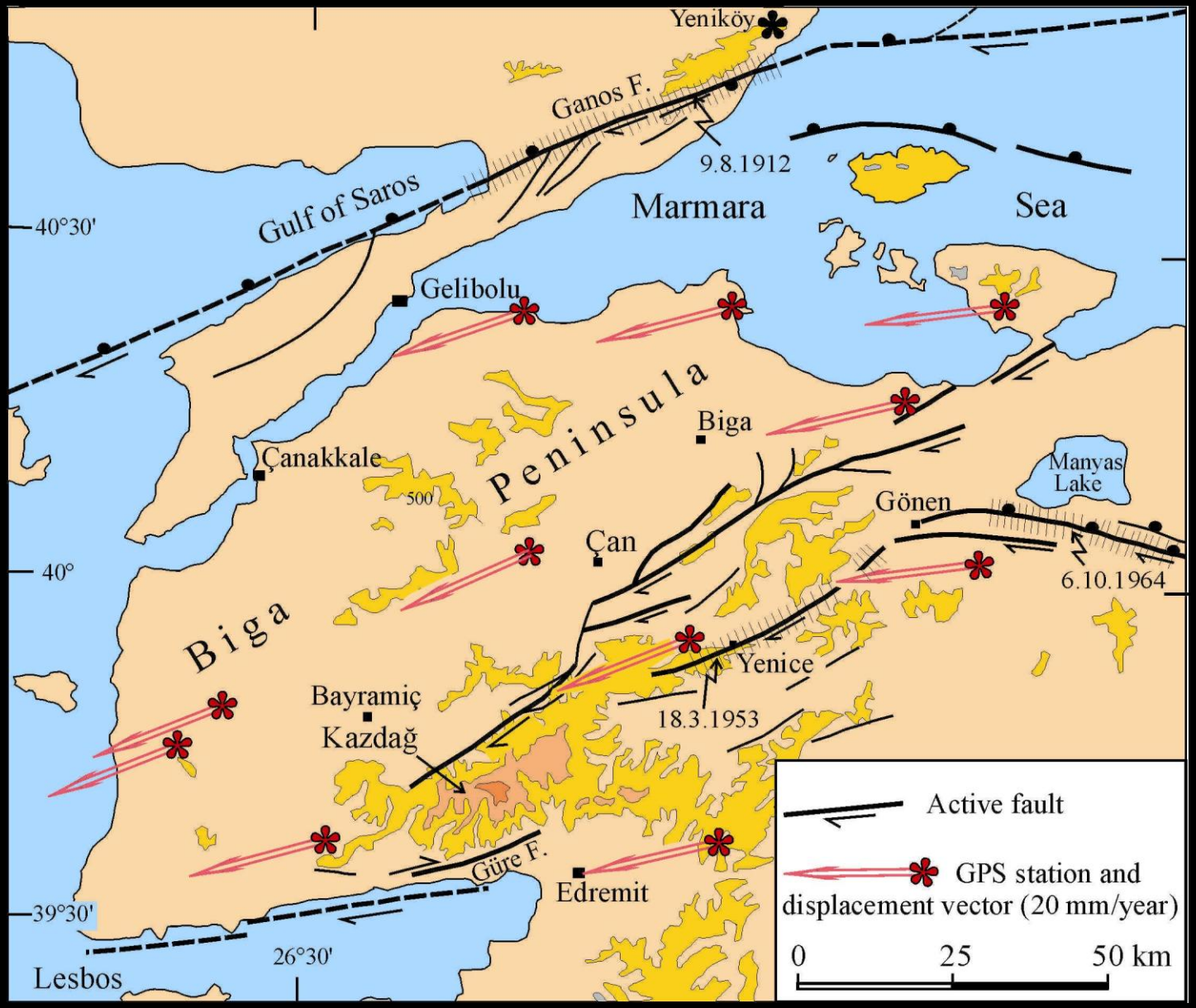

16°
24°
32°
40°
EURASIAN PLATE
Belgrade
Bucharest
Black Sea
Caucasus
44°
Sophia
İstanbul
North Anatolian Fault
40°
Ankara
ANATOLIAN
PLATE
Sea of Marmara
Aegean
Sea
EAF
Bitlis-Zagros collision zone
Athens
Antalya
Calabrian Arc
Hellenic Trench
Cyprus
Mediterranean Ridge
ARABIAN PLATE
Mediterranean
Sea
AFRICAN PLATE
Dead Sea Fault
Jerusalem
0 200 400 km
Alexandrea
Cairo


46°
44°
42°
40°
38°
36°
34°
32°
30°
20°
25°
30°
35°
40°
45°
SOLO
BEUG
ZELB
SHAT
ULKA
BALK
MATS
SACH
KRES
NGU
VANI
NICH
NINO
HOPA
SAMS
AKTO
SINO
HALI
BURG
PLAN
DEMI
SKAL
ASKT
ALEX
DOKU
YENG
IKAN
SMAS
YIG2
ISME
KKIR
AGUZ
DERB
ULDA
GIRE
BALI
ESKI
SIVR
ANKR
YOZG
ABDI
AFYO
DMIR
AYVA
YAYA
AKGA
BAYO
ODME
ALSE
PAMU
BURD
MELE
MERS
SEKI
ANTG
SIRA
KASO
NICO
KATZ
TELA
BARG
MATR
HELW
MEST
SENK
UUUC
DORT
GAZI
SAKZ
MARS
KRMI
ADYI
KRCD
KIZI
MLTY
KMAH
SINC
MERC
PATN
KRKT
KAL2
ARGI
JERM
GORI
NSSP
GARN
IJEV
ARTI
KARS
ISPI
OLTU
ERZU
MMOR
SPEC
OTHO
ANTK
KRTS
KRNA
GAIO
VASI
NEVA
NSKR
HIOS
DISK
SEVA
LOGO
LEON
XNIS
KYNS
MKN2
MILO
KYRA
THIR
ROML
KOMA
ZAKR
CINE
CAMK
MULA
KNID
KAPT
KATV
km
0
200
400
600
20 mm/yr


An
Ae
Sc
Ci
Lu
Ar



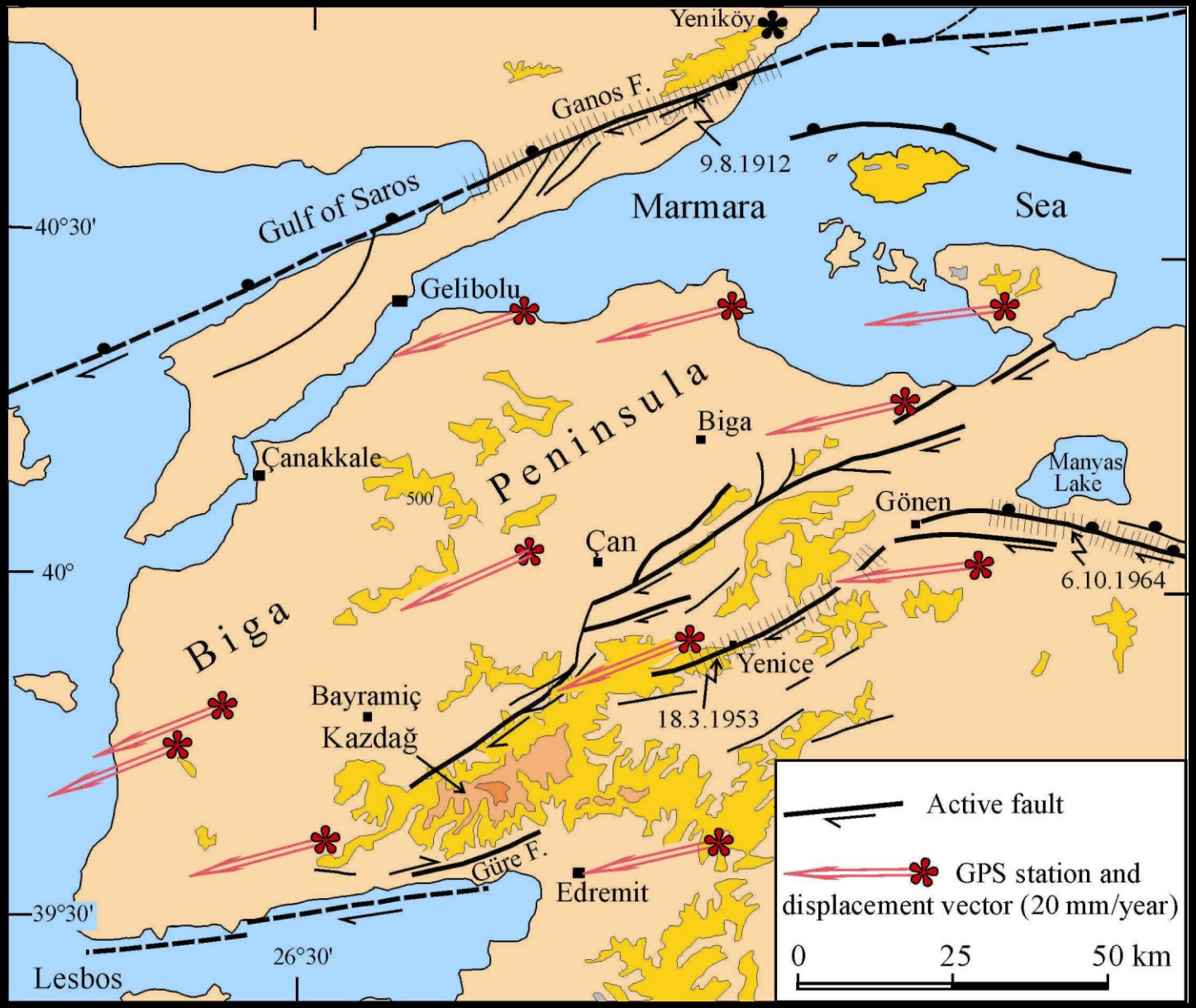



Yeniköy
Ganos F.
9.8.1912
Gulf of Saros
Marmara
Sea
40°30'
Gelibolu
Biga
Peninsula
Çanakkale
500
Manyas
Lake
Gönen
Çan
40°
6.10.1964
Biga
Yenice
Bayramiç
18.3.1953
Kazdağ
Güre F.
Edremit
39°30'
26°30'
Lesbos
Active fault
GPS station and
displacement vector (20 mm/year)
0
25
50 km

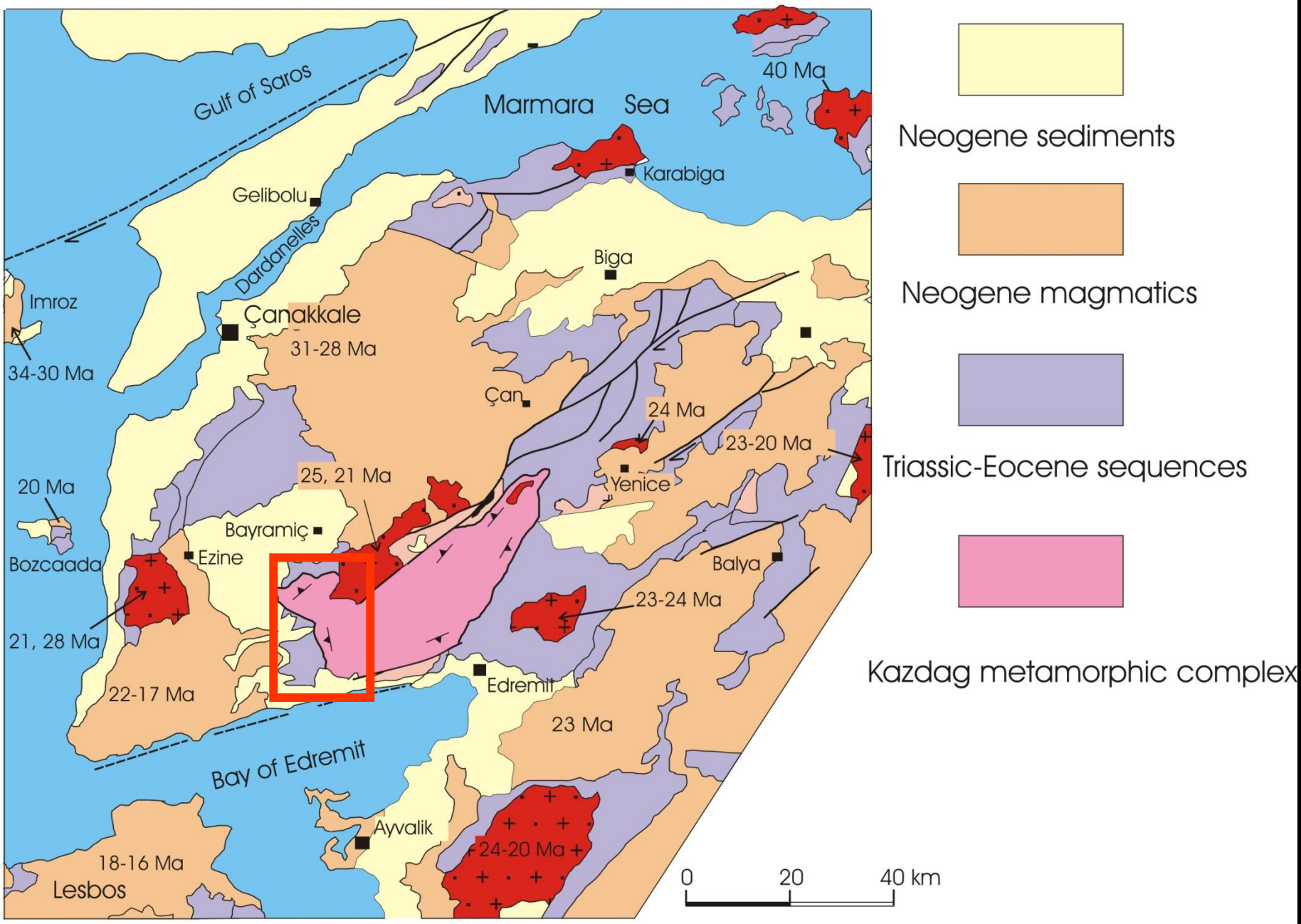


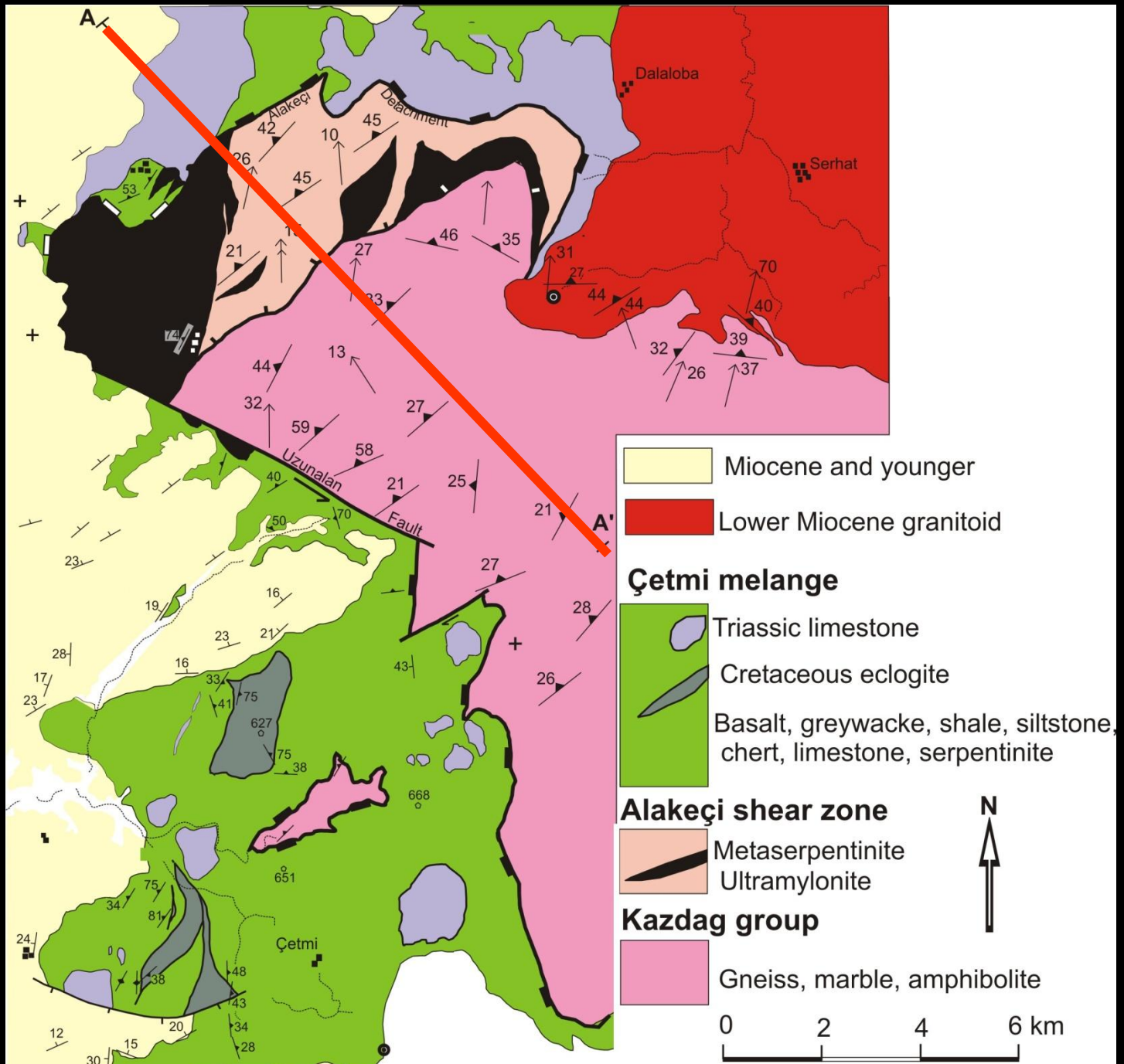


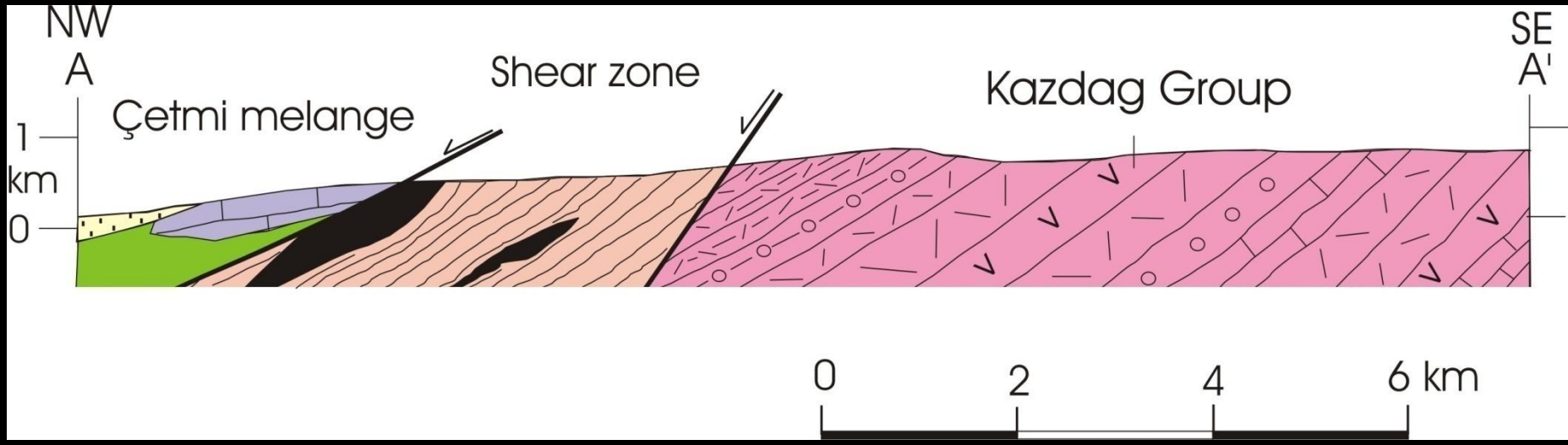


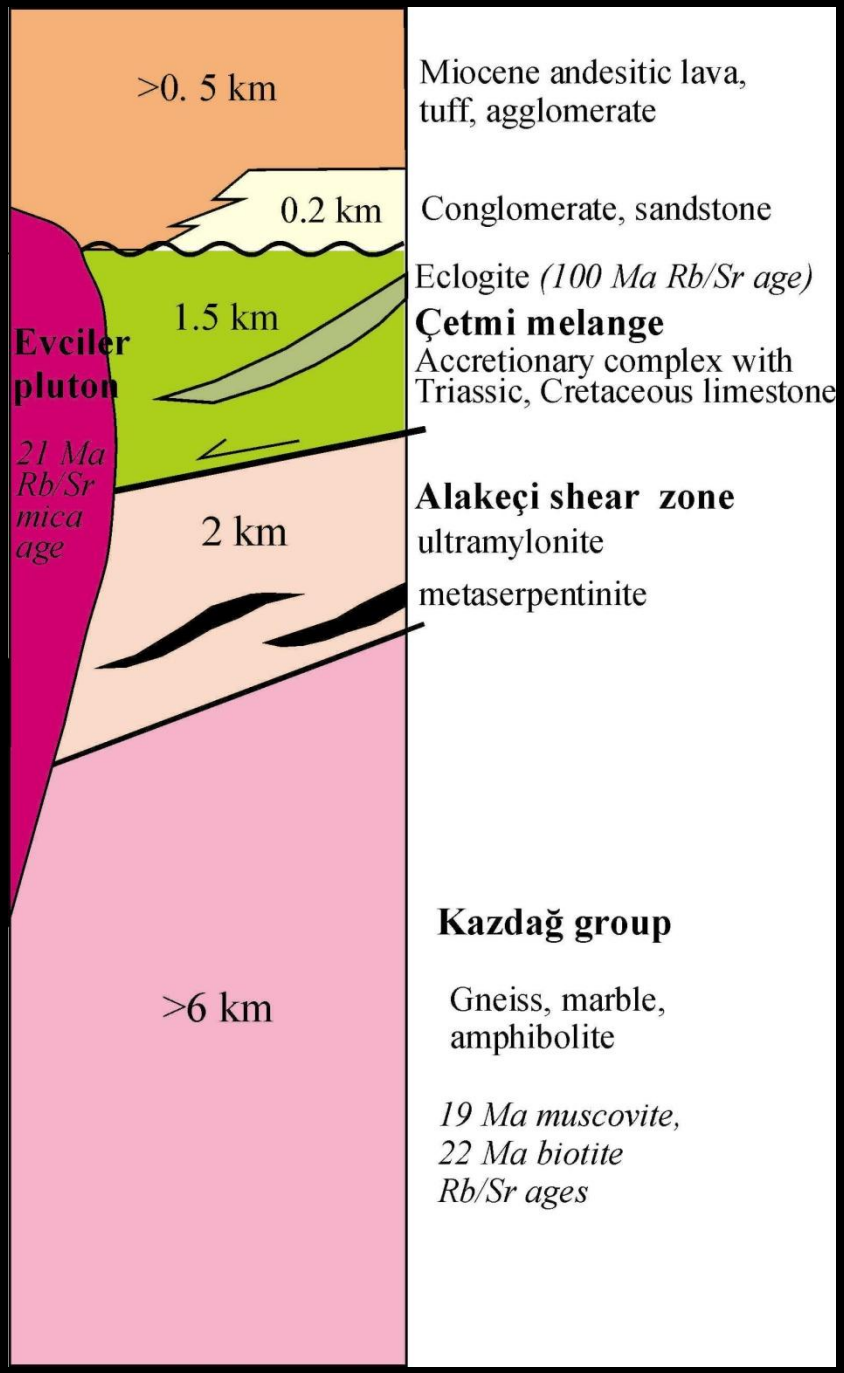

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500
Manyas
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40°
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18.3.1953
Kazdağ
Güre F.
Edremit
39°30'
26°30'
Lesbos
Active fault
GPS station and
displacement vector (20 mm/year)
0
25
50 km




Gulf of Saros
Marmara Sea
40 Ma
Karabiga
Gelibolu
Dardanelles
Biga
Imroz
Çanakkale
31-28 Ma
34-30 Ma
Çan
24 Ma
23-20 Ma
Yenice
25, 21 Ma
20 Ma
Bayramiç
Ezine
Bozcaada
Balya
23-24 Ma
21, 28 Ma
22-17 Ma
Edremit
23 Ma
Bay of Edremit
Ayvalik
24-20 Ma
18-16 Ma
Lesbos
0
20
40 km
Neogene sediments
Neogene magmatics
Triassic-Eocene sequences
Kazdag metamorphic complex


A
A'
Alakeçi
Detachment
Uzunalan
Fault
Dalaloba
Serhat
Çetmi
Miocene and younger
Lower Miocene granitoid
Çetmi melange
Triassic limestone
Cretaceous eclogite
Basalt, greywacke, shale, siltstone, chert, limestone, serpentinite
Alakeçi shear zone
Metaserpentinite
Ultramylonite
Kazdag group
Gneiss, marble, amphibolite
N
0
2
4
6 km


NW
A
Çetmi melange
Shear zone
Kazdag Group
SE
A'
1
km
0
0
2
4
6 km


>0. 5 km
Miocene andesitic lava, tuff, agglomerate
0.2 km
Conglomerate, sandstone
Eclogite (100 Ma Rb/Sr age)
1.5 km
Çetmi melange
Accretionary complex with Triassic, Cretaceous limestone
Evciler pluton
21 Ma Rb/Sr mica age
Alakeçi shear zone
ultramylonite
2 km
metaserpentinite
Kazdağ group
>6 km
Gneiss, marble, amphibolite
19 Ma muscovite,
22 Ma biotite
Rb/Sr ages



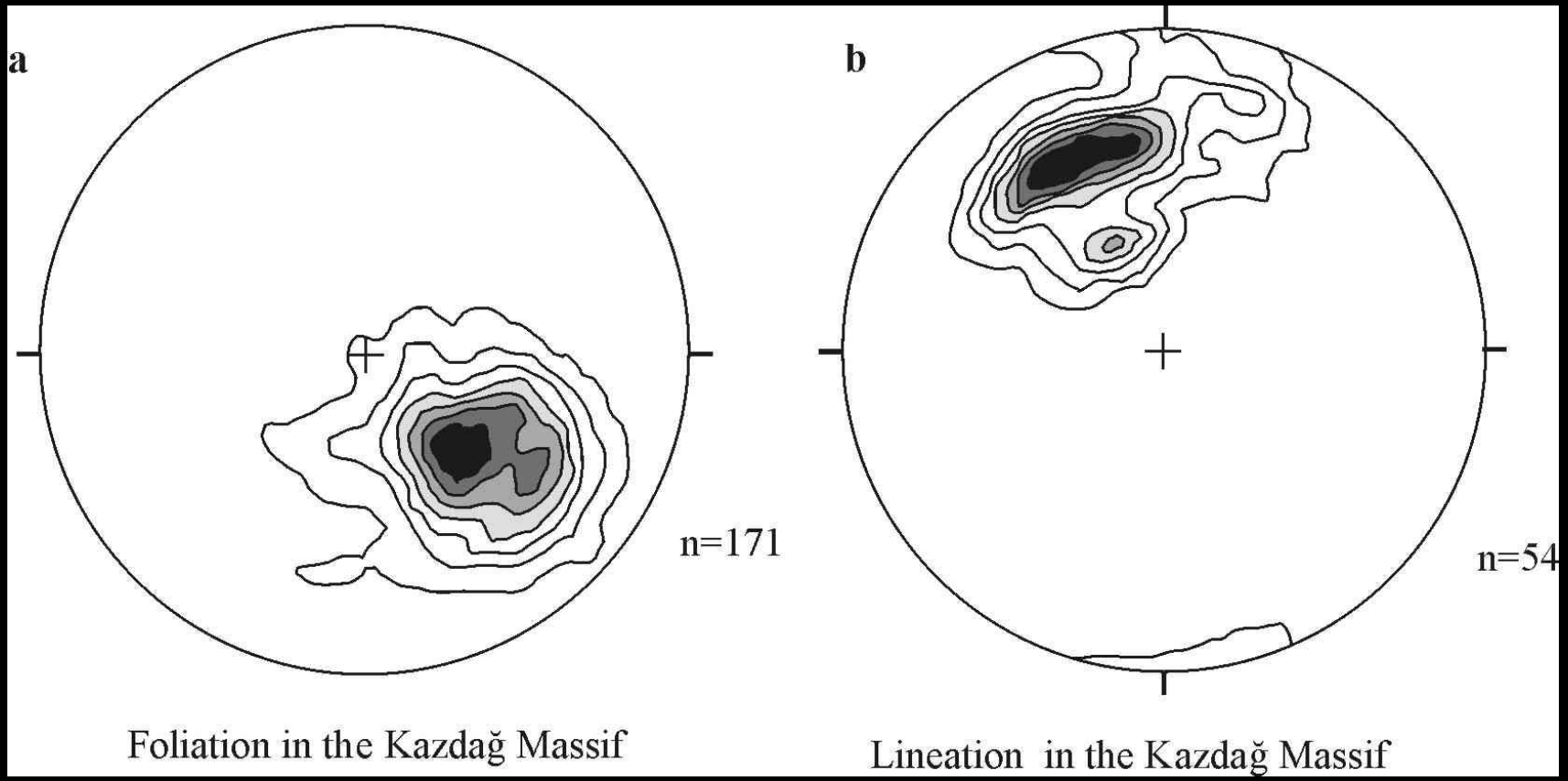


Yapısal veriler

sünek (duktil) deformasyon

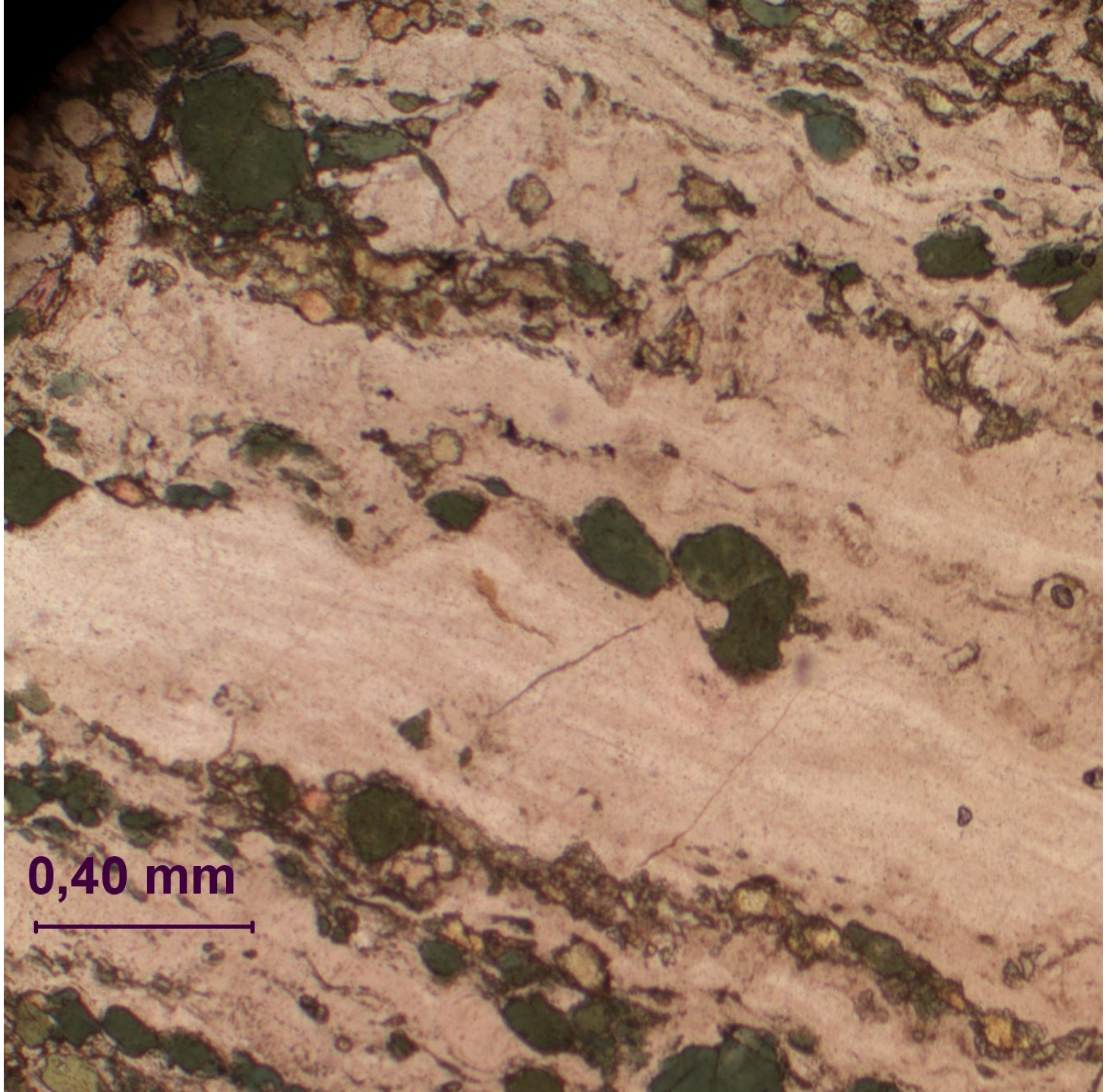
foliasyon, lineasyon, kıvrım

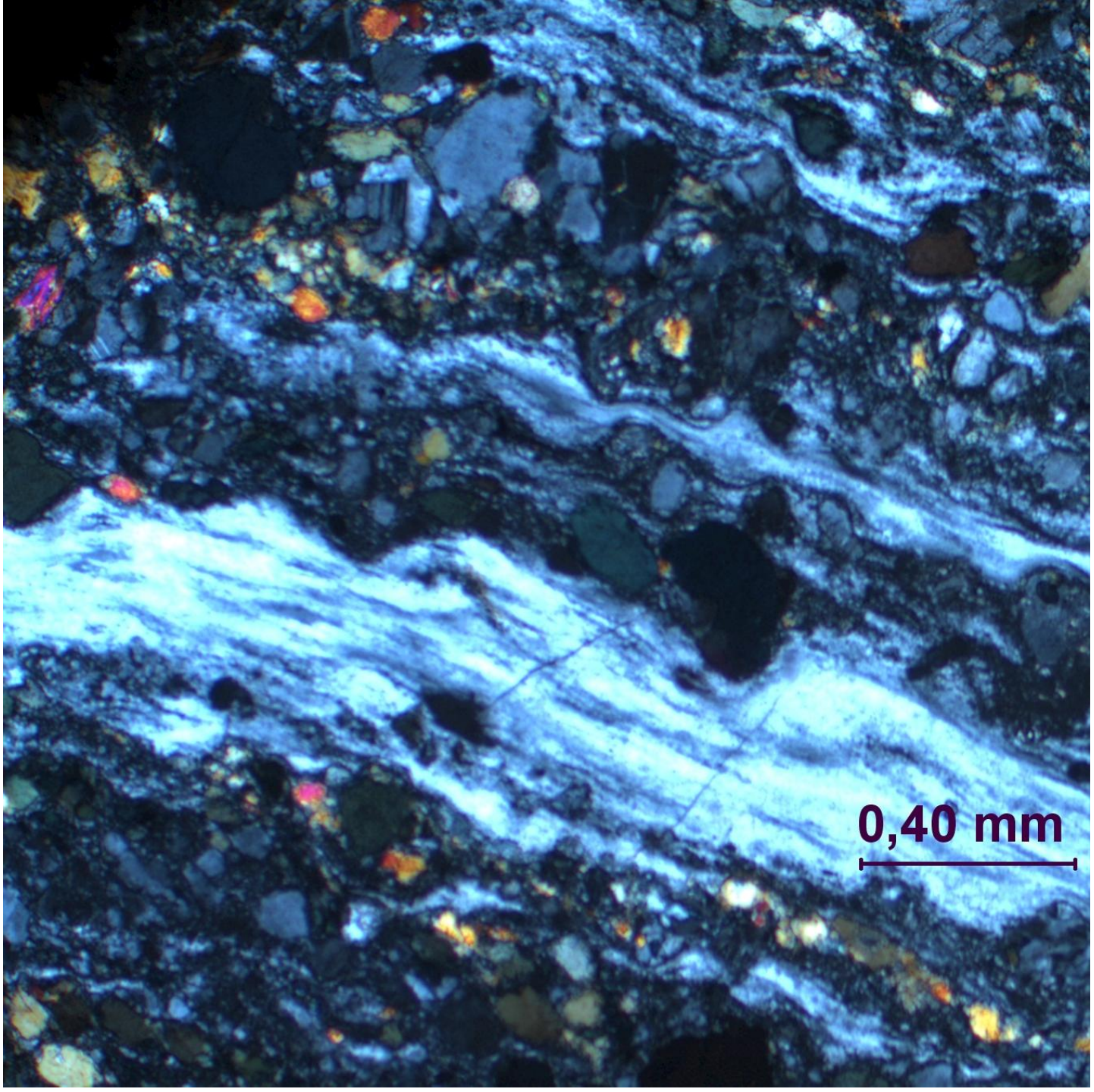


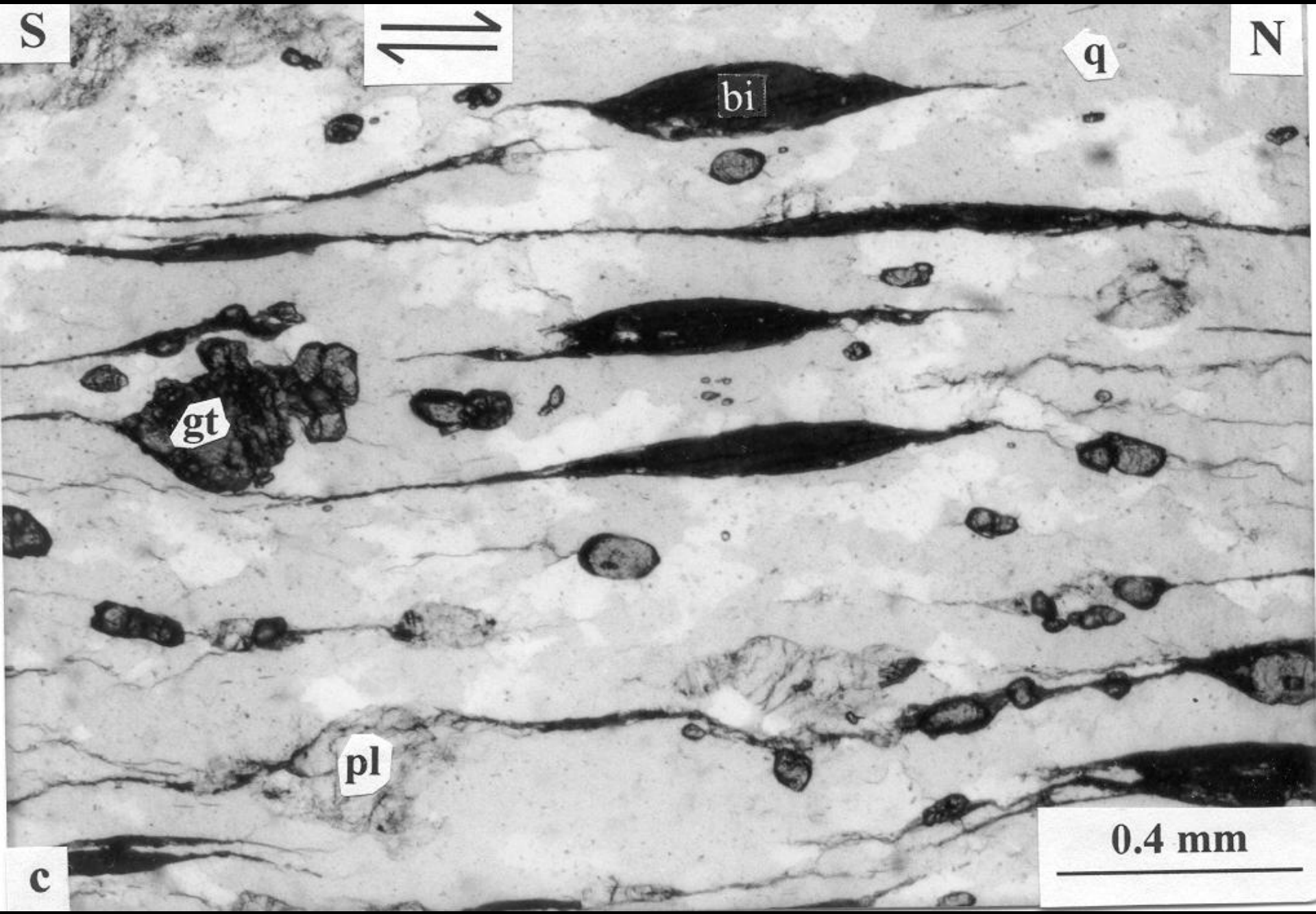


Foliation in the Kazdağ Massif

Lineation in the Kazdağ Massif


0,40 mm


0,40 mm


S
N
q
bi
gt
pl
0.4 mm
c

Yapısal veriler

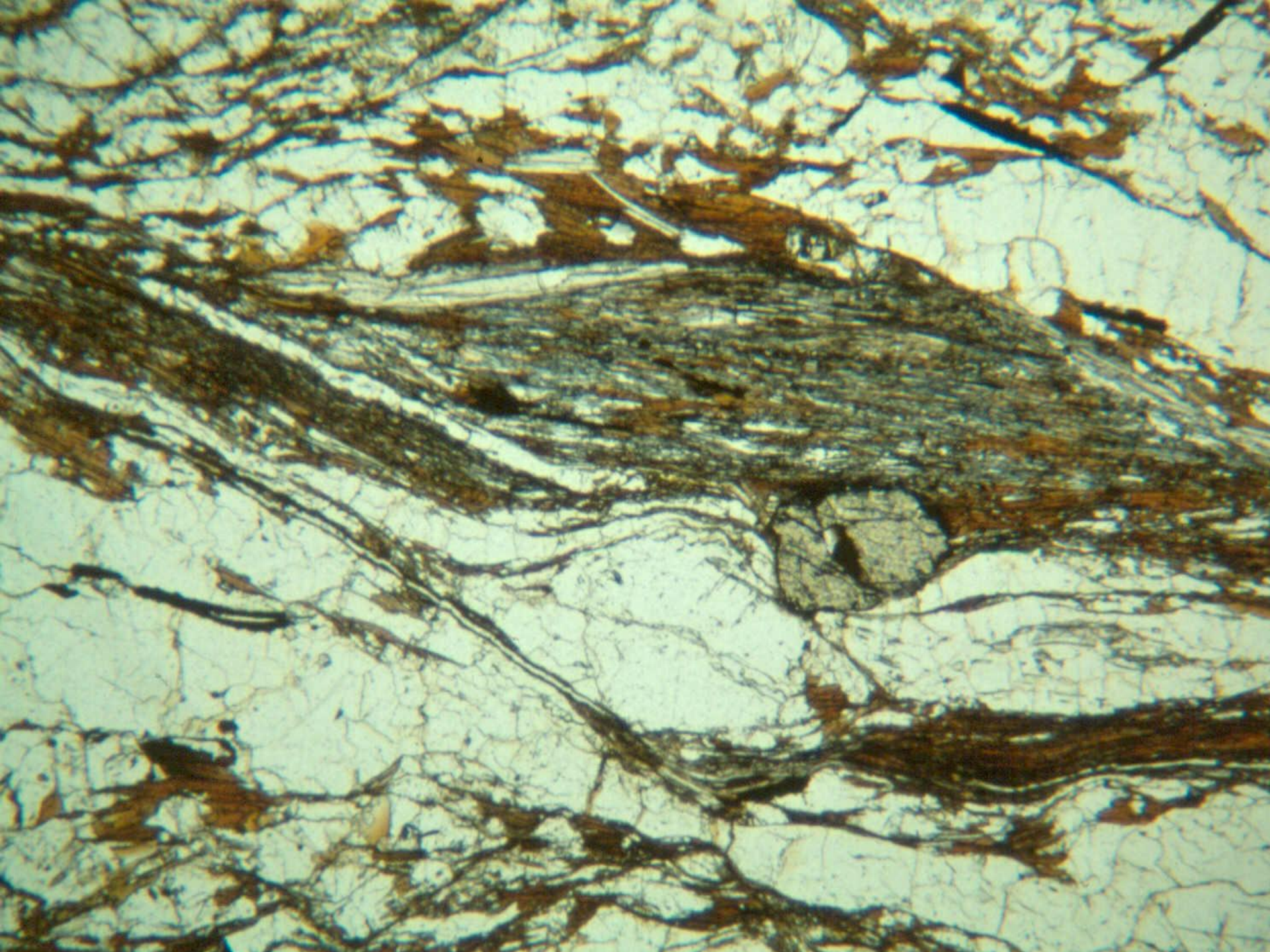
kırılgan deformasyon

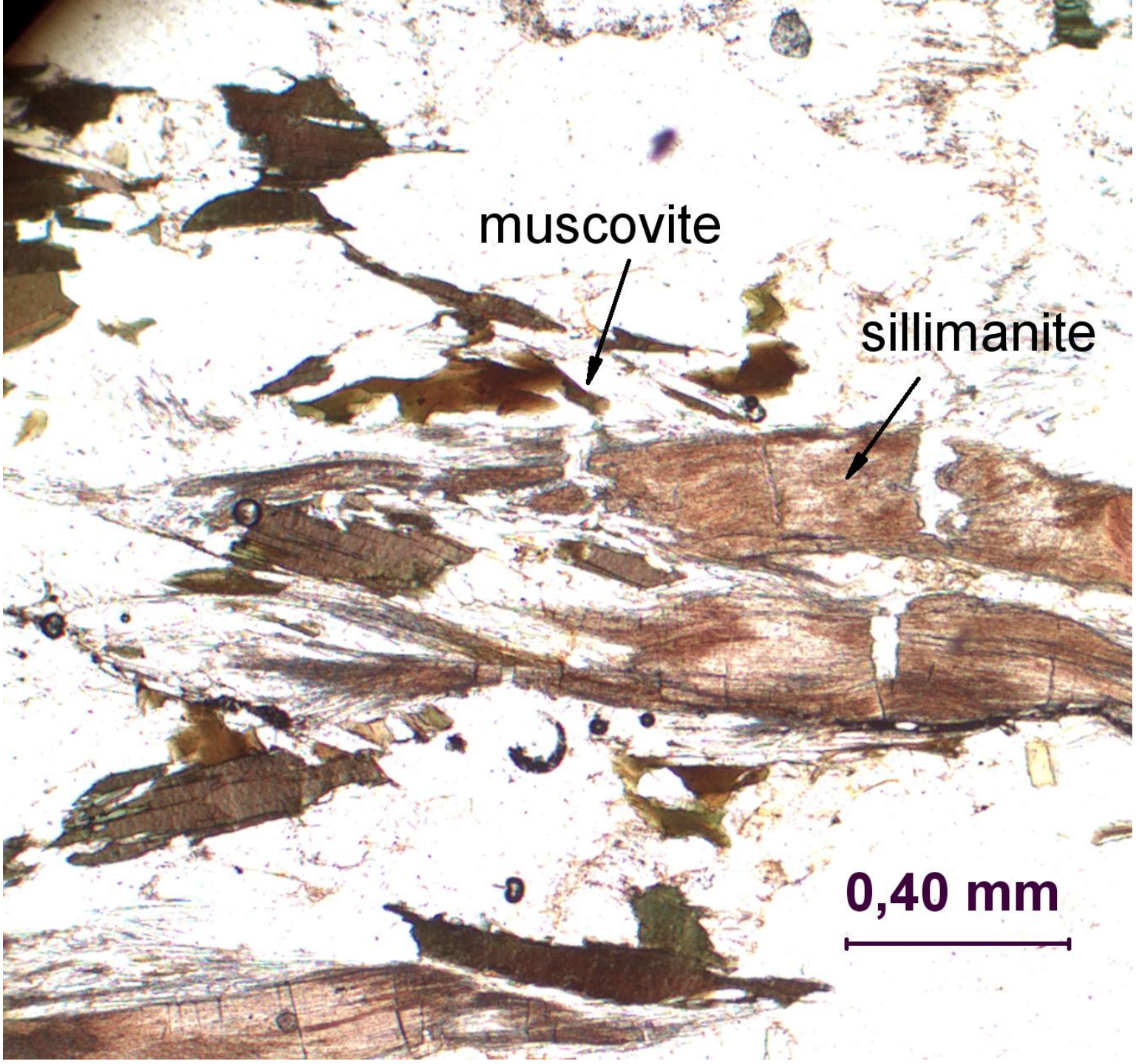
fay ve çatlaklar

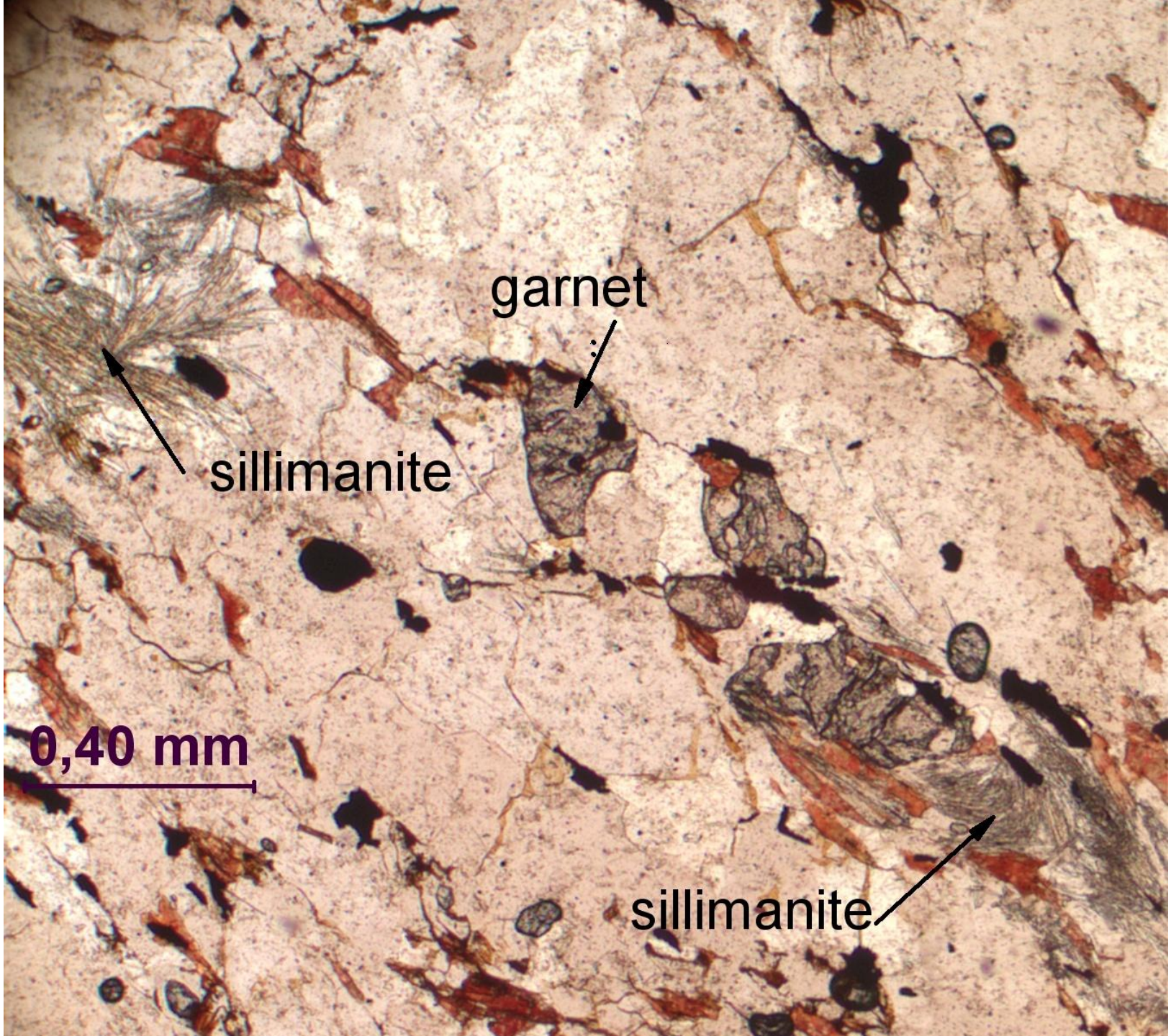


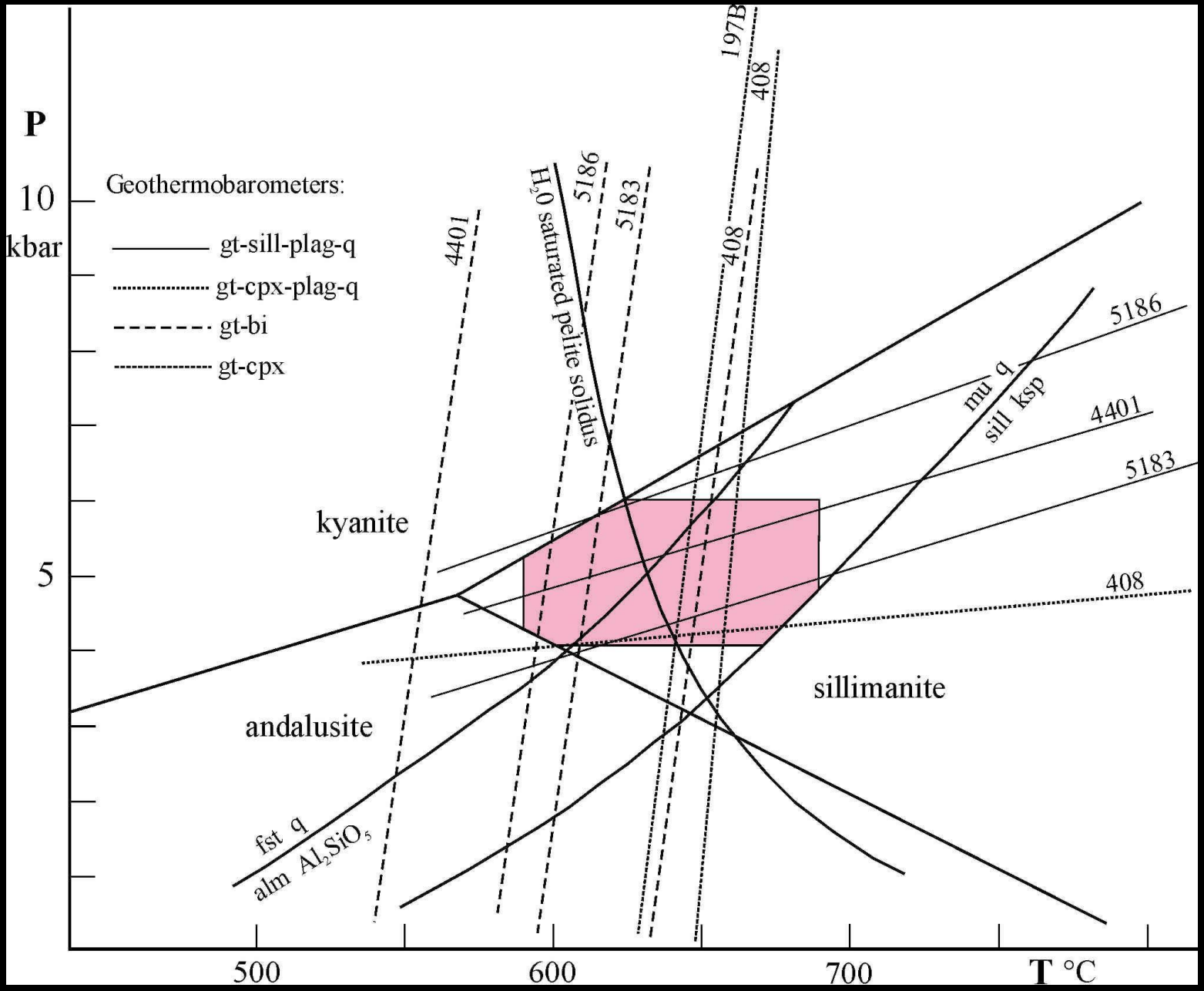


Metamorfizma sırasında basınç-sıcaklık koşullarının saptanması



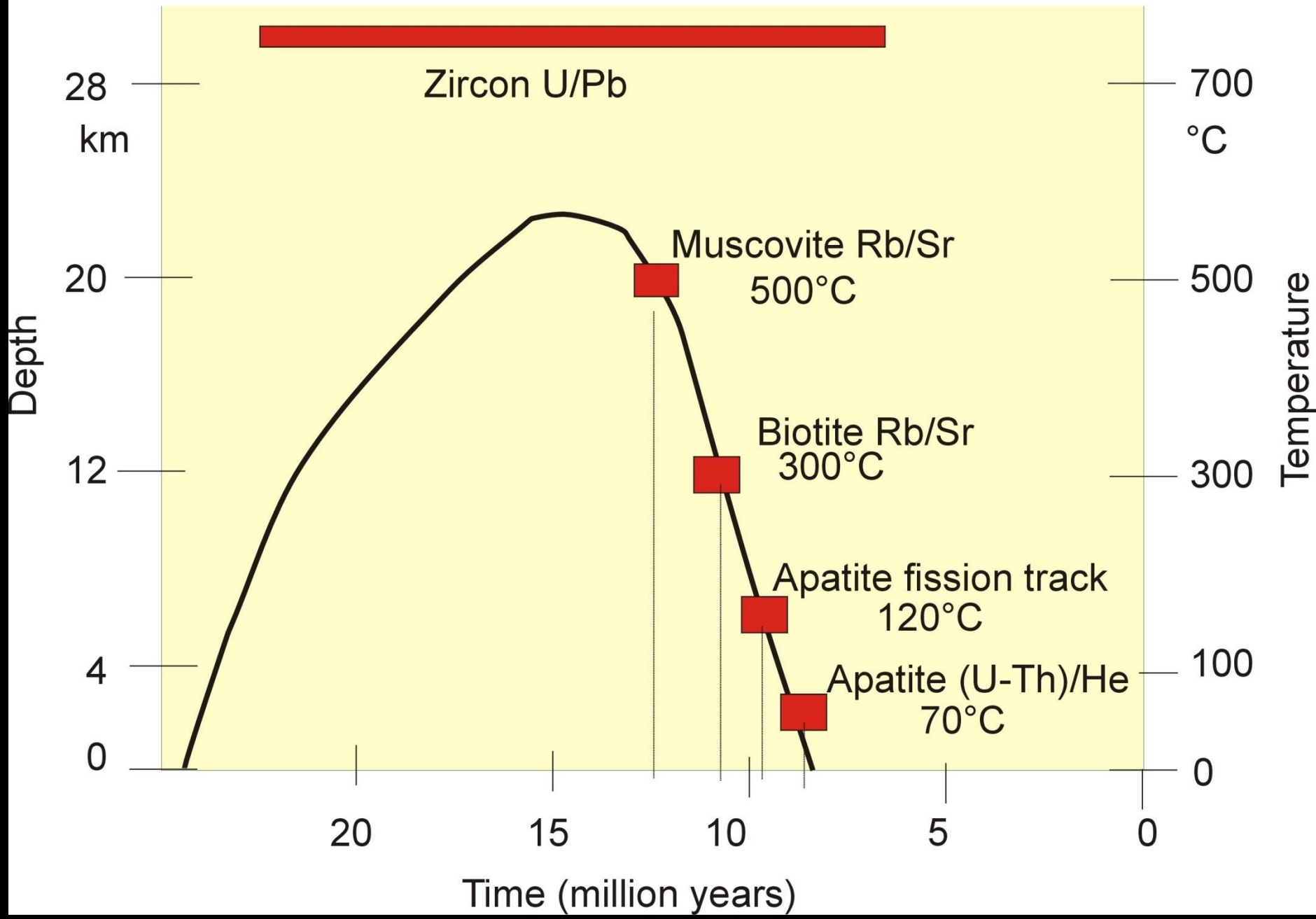

muscovite
sillimanite
0,40 mm


garnet
sillimanite
0,40 mm
sillimanite


P
10
kbar
5
Geothermobarometers:
gt-sill-plag-q
gt-cpx-plag-q
gt-bi
gt-cpx
4401
H2O saturated pelite solidus
5186
5183
408
197B
408
5186
mu q
sill ksp
4401
5183
408
kyanite
andalusite
sillimanite
fst q
alm Al2SiO5
500
600
700
T °C

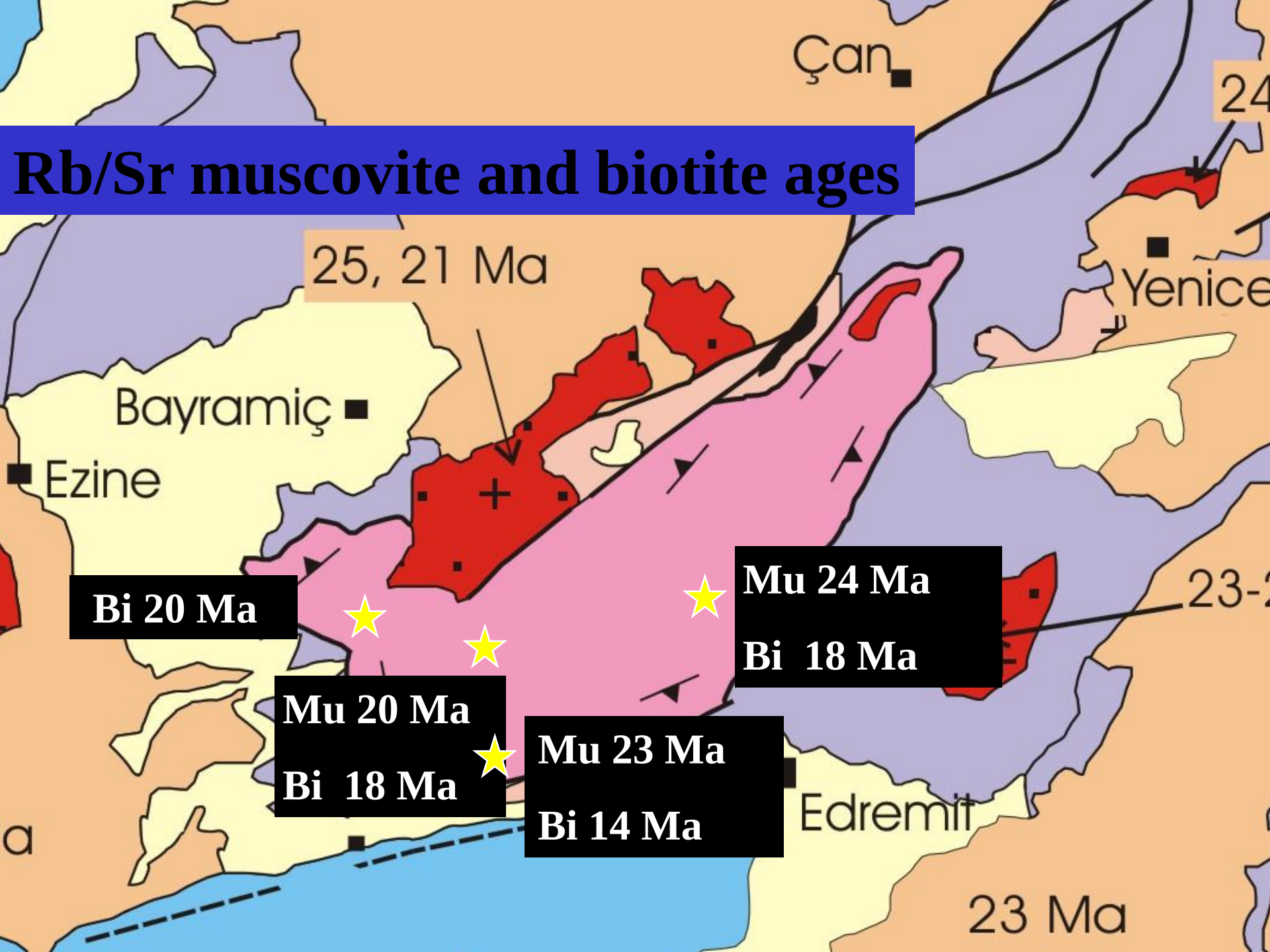
Metamorfizma yaşının izotopik yöntemle saptanması

Rb/Sr yöntemi


Zircon U/Pb
Muscovite Rb/Sr
500°C
Biotite Rb/Sr
300°C
Apatite fission track
120°C
Apatite (U-Th)/He
70°C
28
km
20
12
4
0
Depth
700
°C
500
300
100
0
Temperature
20
15
10
5
0
Time (million years)

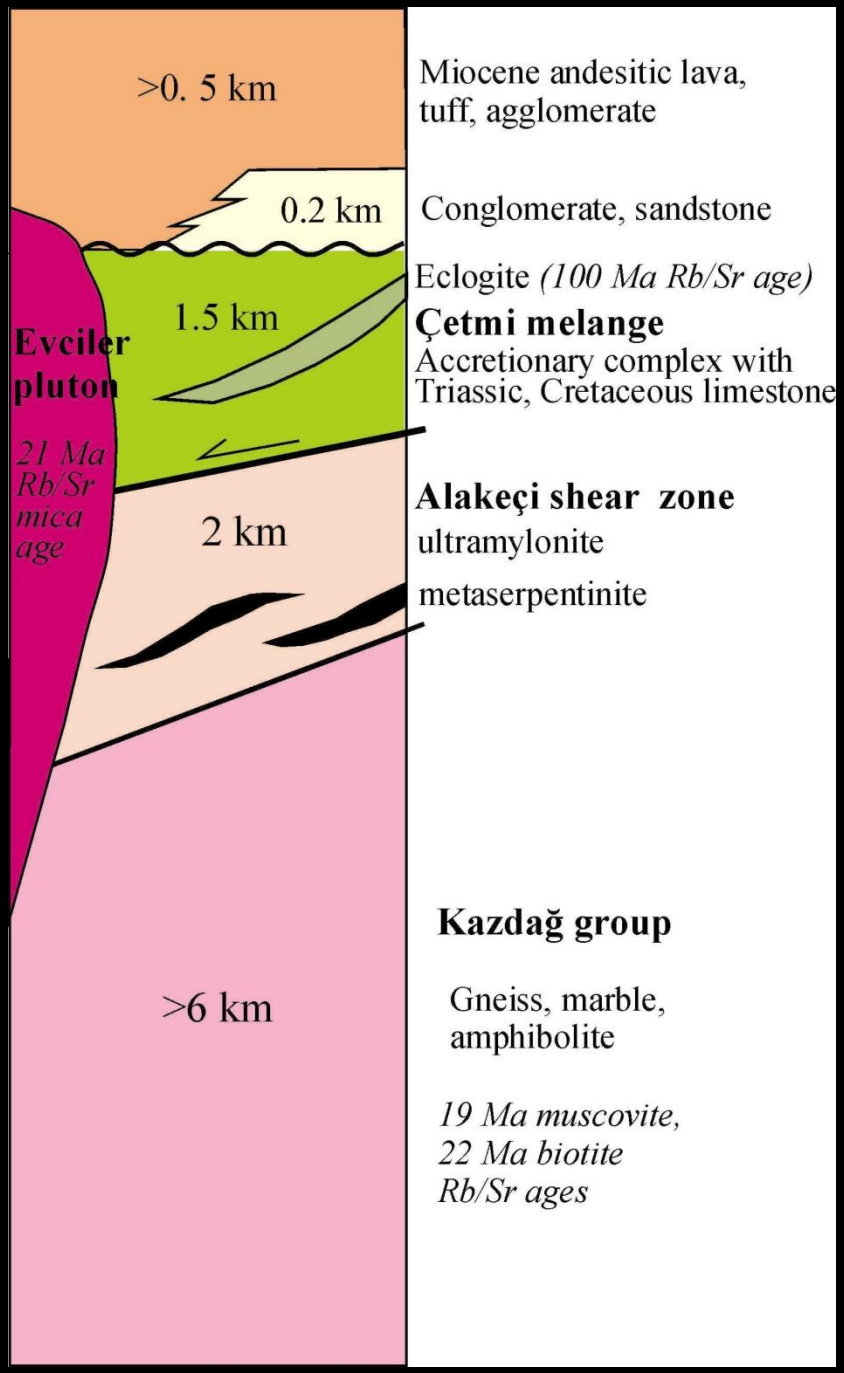
Rb/Sr isotopic data from the Kazdağ region

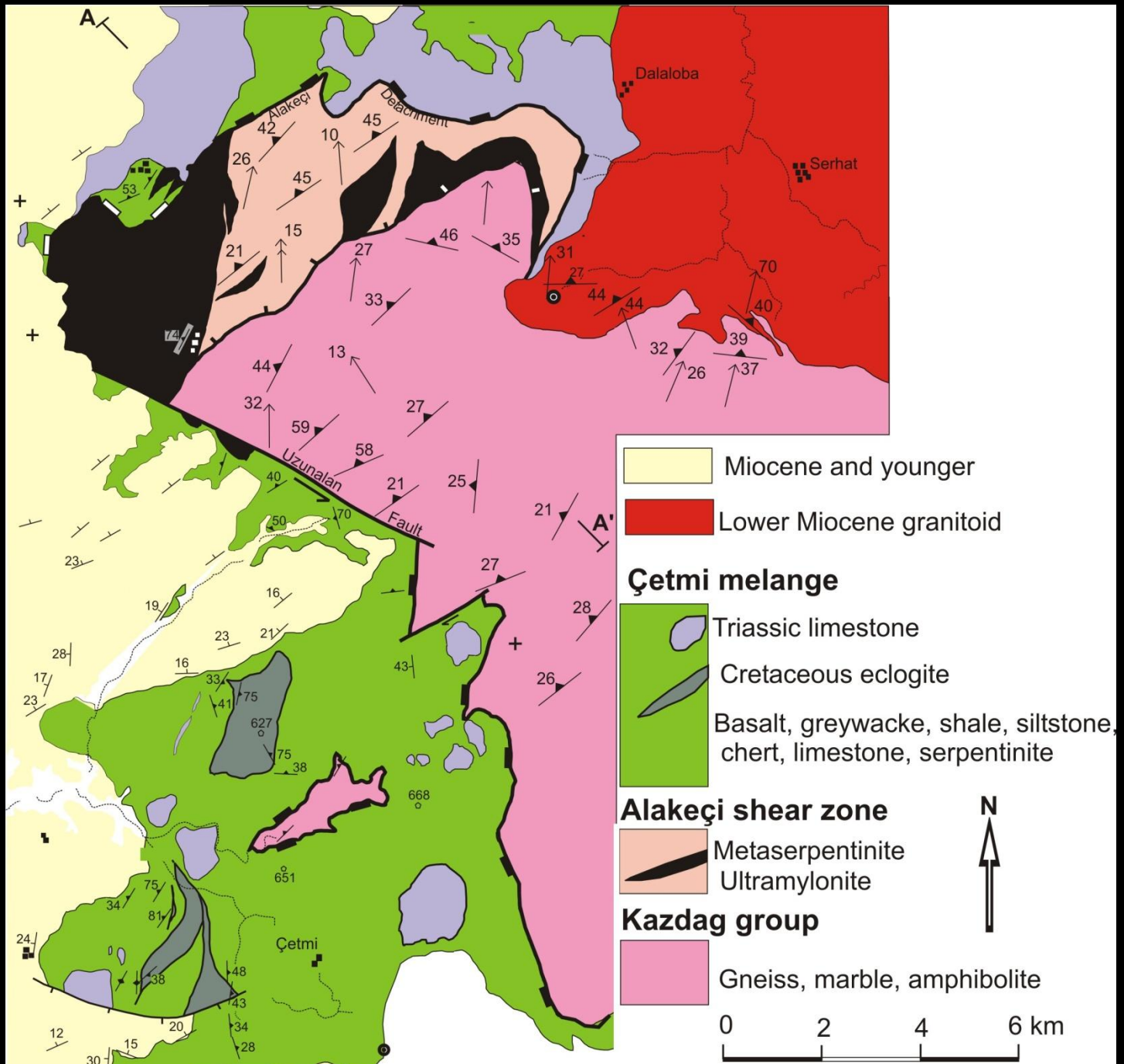
Sample	Mineral	Rb, ppm	Sr, ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	**Age, Ma**
			Kazdağ Gneisses			
1	rock	27	86	0,91	0,708075	
	biotite	401	9,89	118	0,728979	**14 ± 0.1**
2	rock	125	140	2,59	0,719144	
	muscovite	366	10,22	104,0	0,752084	**23 ± 0.2**
3	rock	141	125	3,27	0,724328	
	muscovite	428	13,09	95,1	0,756055	**24 ± 0.3**
4	rock	68	143	1,38	0,714796	
	biotite	362	2,28	466	0,841167	**19 ± 0.2**
5	rock	79	112	2,04	0,716478	
	muscovite	363	9,77	108	0,747145	**20 ± 0.2**
6	rock	73	237	0,89	0,714226	
	muscovite	187	24,27	22,3	0,720344	**20 ± 0.2**
	biotite	367	3,40	315	0,796095	**18 ± 0.2**
7	rock	102	164	1,80	0,718284	
	biotite	475	2,27	616	0,887441	**19 ± 0.2**
8	rock	152	100	4,41	0,728559	
	biotite	646	1,77	1090	1,012891	**18 ± 0.2**
195B	rock	56	575	0,282	0,70693	
	muscovite	207	93,2	6,427	0,70952	**30 ± 0.4**
	biotite	433	12	104,69	0,73701	**20 ± 0.2**
	plagioclase	12,5	628	0,058	0,70679	


Rb/Sr muscovite and biotite ages
Çan
25, 21 Ma
Yenice
Bayramiç
Ezine
Bi 20 Ma
Mu 24 Ma
Bi 18 Ma
Mu 20 Ma
Bi 18 Ma
Mu 23 Ma
Bi 14 Ma
Edremit
23 Ma

Alakeçi Milonit Zonu

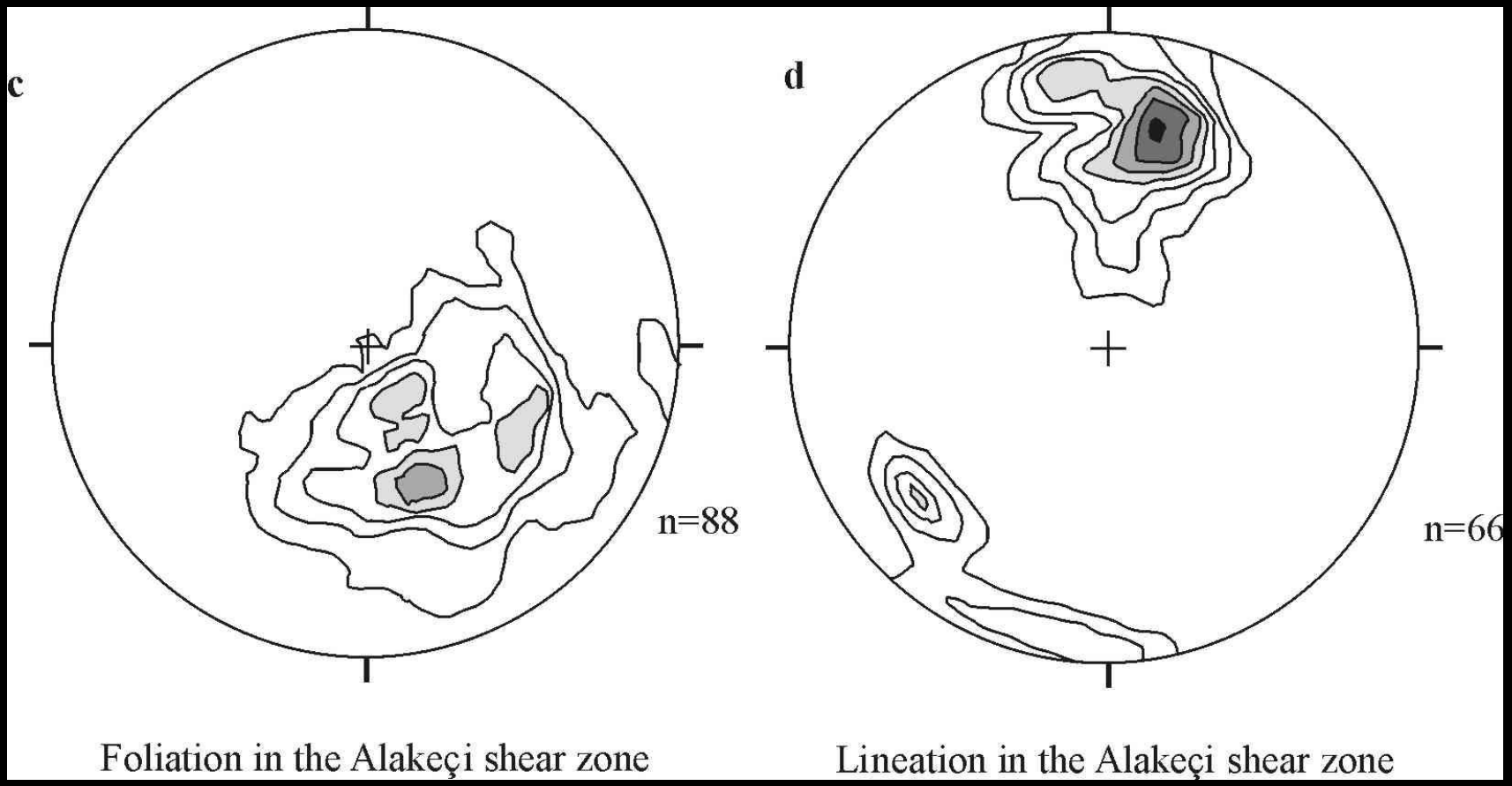
Genişlemeyi derinde karşılayan bir makaslama zonu


>0. 5 km
Miocene andesitic lava, tuff, agglomerate
0.2 km
Conglomerate, sandstone
Eclogite (100 Ma Rb/Sr age)
1.5 km
Çetmi melange
Accretionary complex with Triassic, Cretaceous limestone
Evciler pluton
21 Ma Rb/Sr mica age
Alakeçi shear zone
ultramylonite
2 km
metaserpentinite
Kazdağ group
>6 km
Gneiss, marble, amphibolite
19 Ma muscovite,
22 Ma biotite
Rb/Sr ages


A
A'
Alakeçi
Detachment
Uzunalan
Fault
Dalaloba
Serhat
Çetmi
Miocene and younger
Lower Miocene granitoid
Çetmi melange
Triassic limestone
Cretaceous eclogite
Basalt, greywacke, shale, siltstone, chert, limestone, serpentinite
Alakeçi shear zone
Metaserpentinite
Ultramylonite
Kazdag group
Gneiss, marble, amphibolite
N
0 2 4 6 km





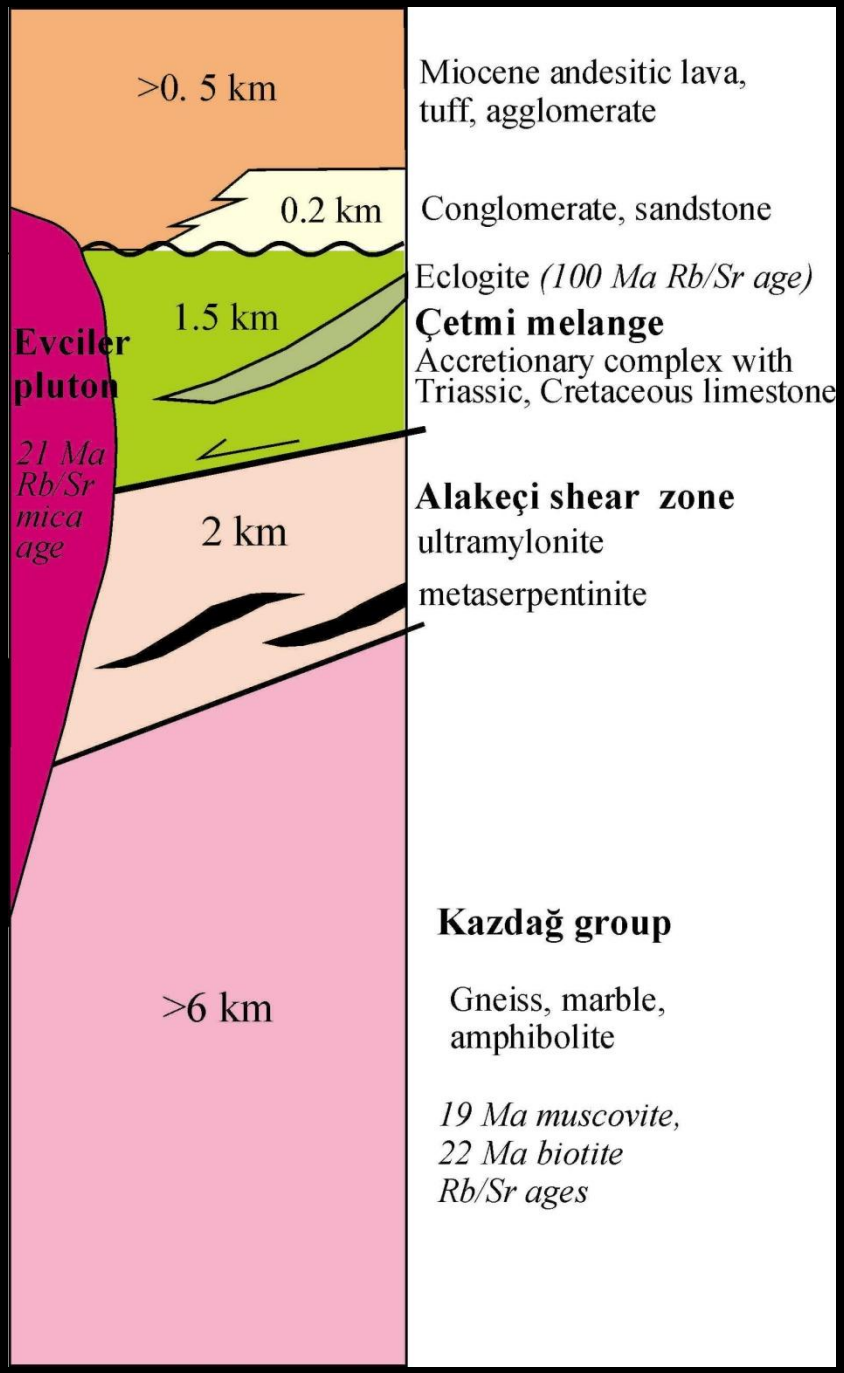


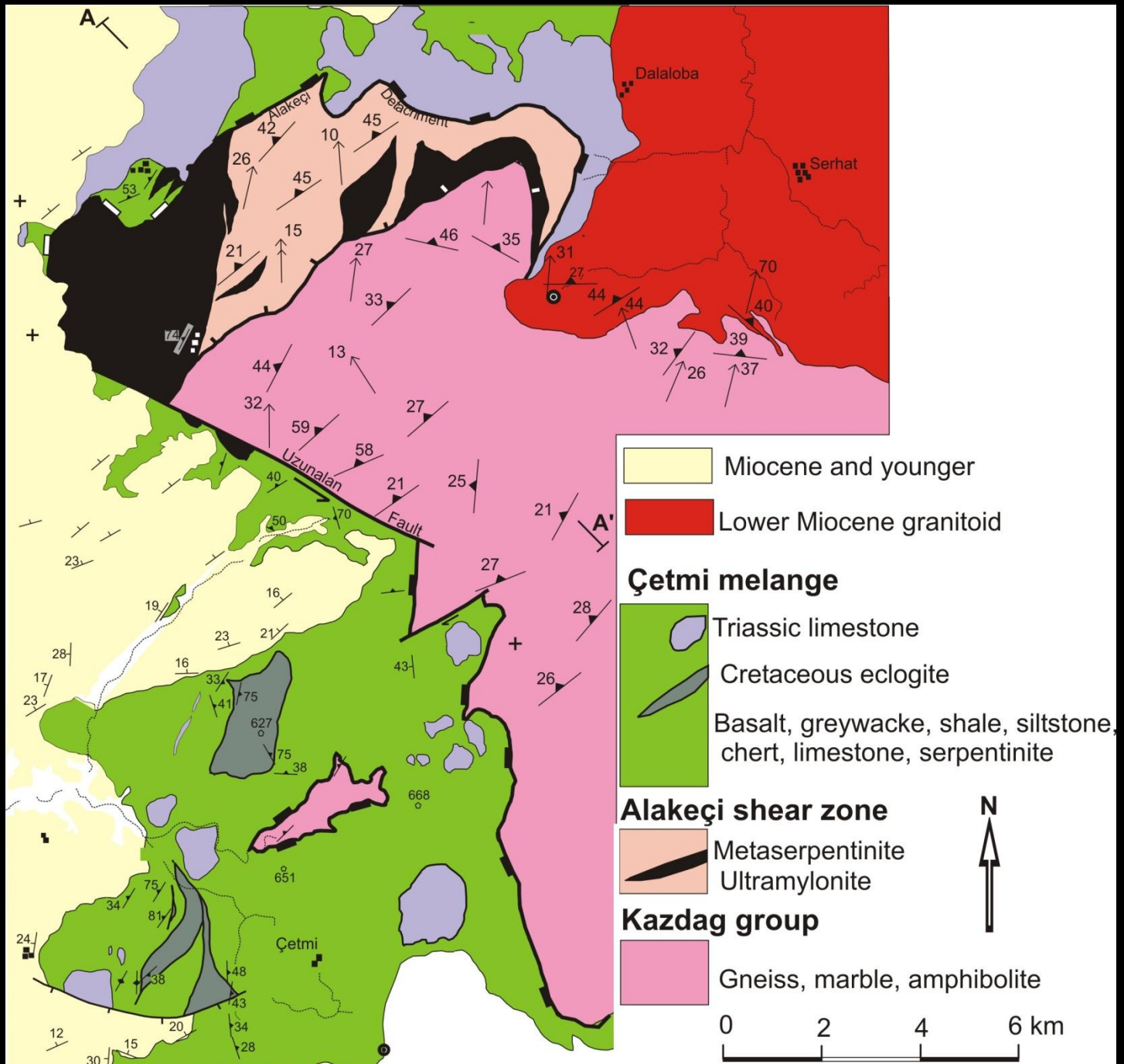
Foliation in the Alakeçi shear zone

Lineation in the Alakeçi shear zone

Çetmi Ofiyolitli Melanjı

Neo-Tetis okyanusunun dalma-batma kompleksi


>0. 5 km
Miocene andesitic lava, tuff, agglomerate
0.2 km
Conglomerate, sandstone
Eclogite (100 Ma Rb/Sr age)
1.5 km
Çetmi melange
Accretionary complex with Triassic, Cretaceous limestone
Evciler pluton
21 Ma Rb/Sr mica age
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2 km
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19 Ma muscovite,
22 Ma biotite
Rb/Sr ages


A
A'
Alakeçi
Detachment
Uzunalan
Fault
Dalaloba
Serhat
Çetmi
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Lower Miocene granitoid
Çetmi melange
Triassic limestone
Cretaceous eclogite
Basalt, greywacke, shale, siltstone, chert, limestone, serpentinite
Alakeçi shear zone
Metaserpentinite
Ultramylonite
Kazdag group
Gneiss, marble, amphibolite
N
0 2 4 6 km



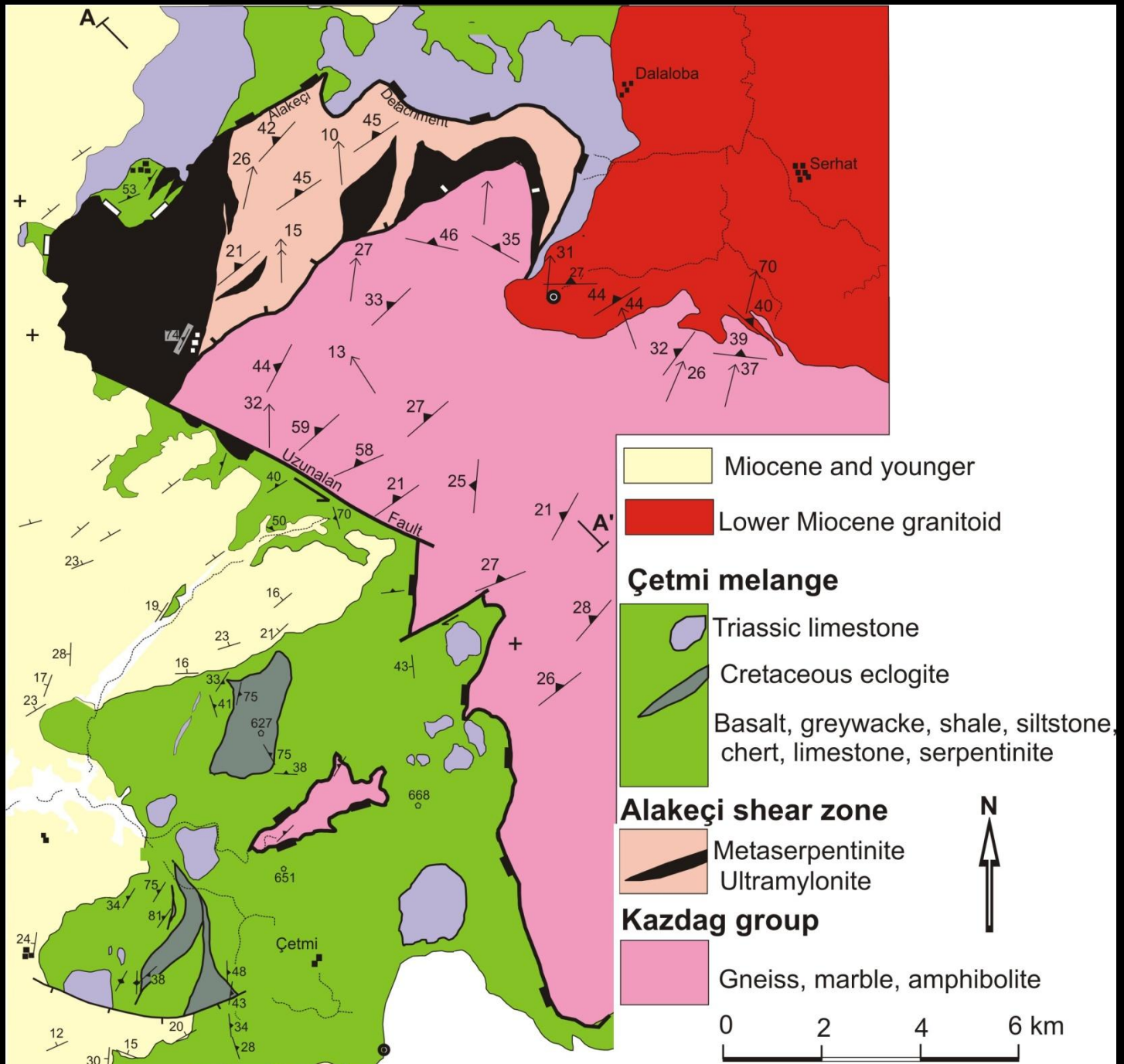




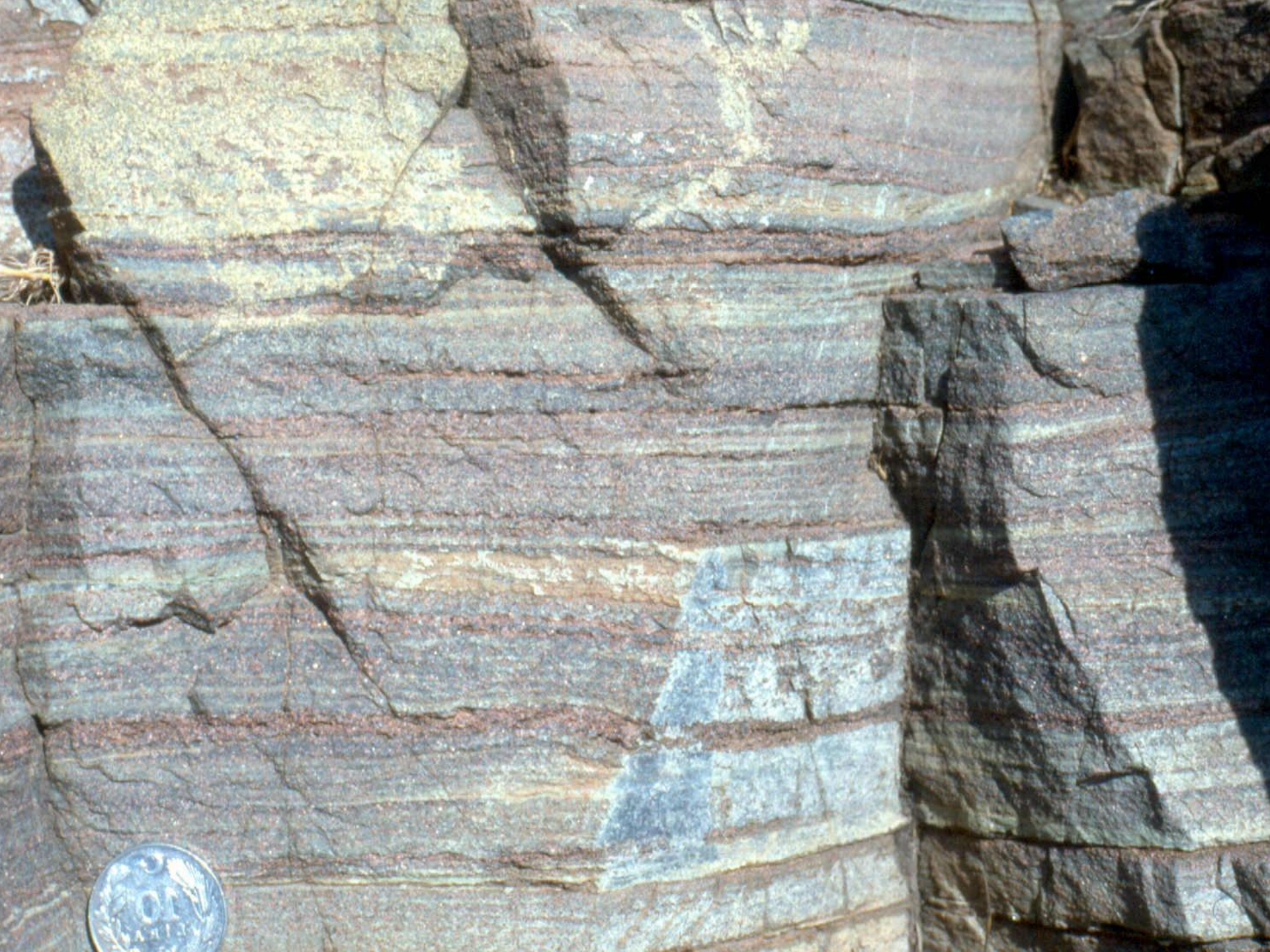






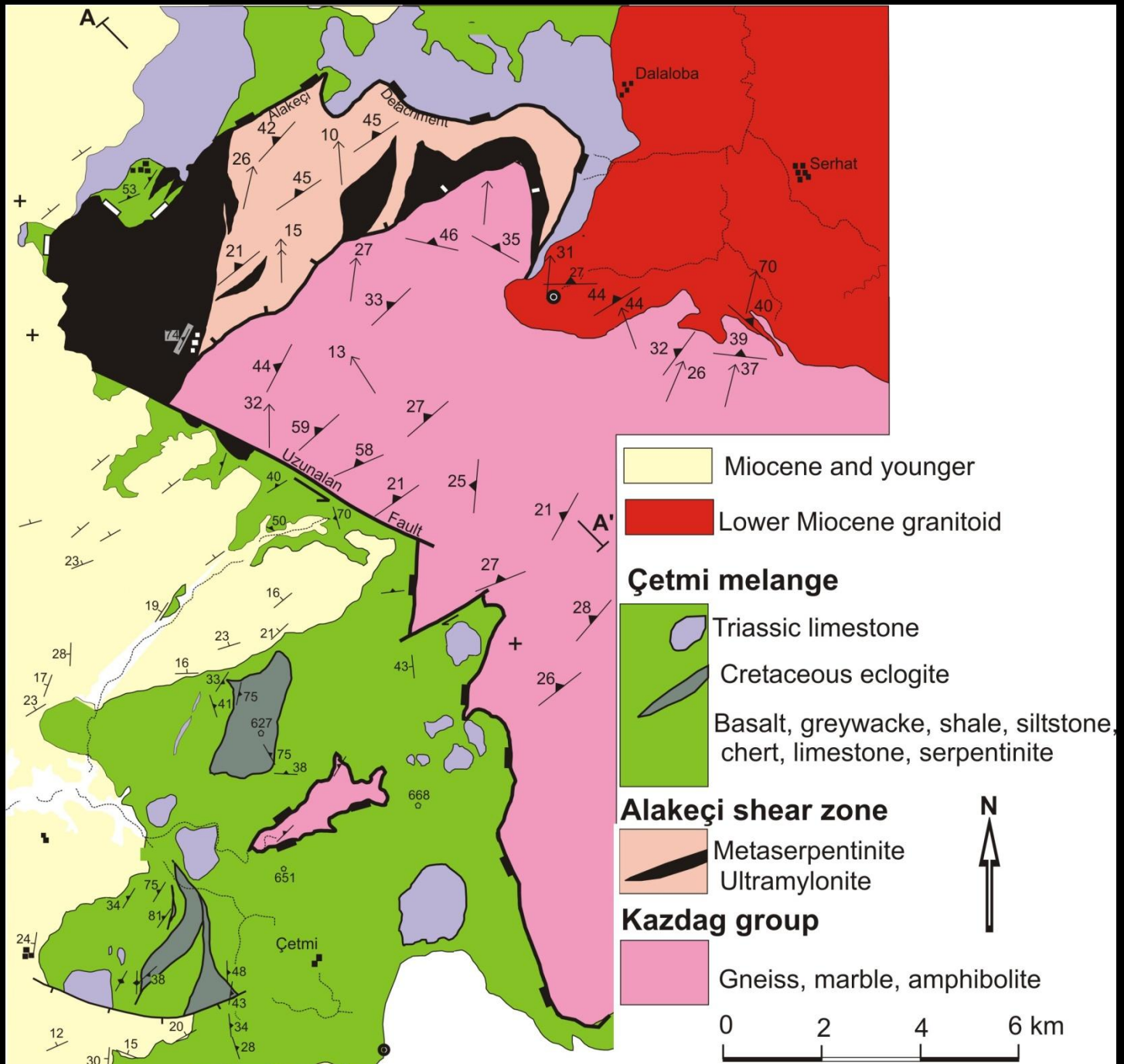

A
A'
Alakeçi
Detachment
Uzunalan
Fault
Dalaloba
Serhat
Çetmi
Miocene and younger
Lower Miocene granitoid
Çetmi melange
Triassic limestone
Cretaceous eclogite
Basalt, greywacke, shale, siltstone, chert, limestone, serpentinite
Alakeçi shear zone
Metaserpentinite
Ultramylonite
Kazdag group
Gneiss, marble, amphibolite
N
0 2 4 6 km

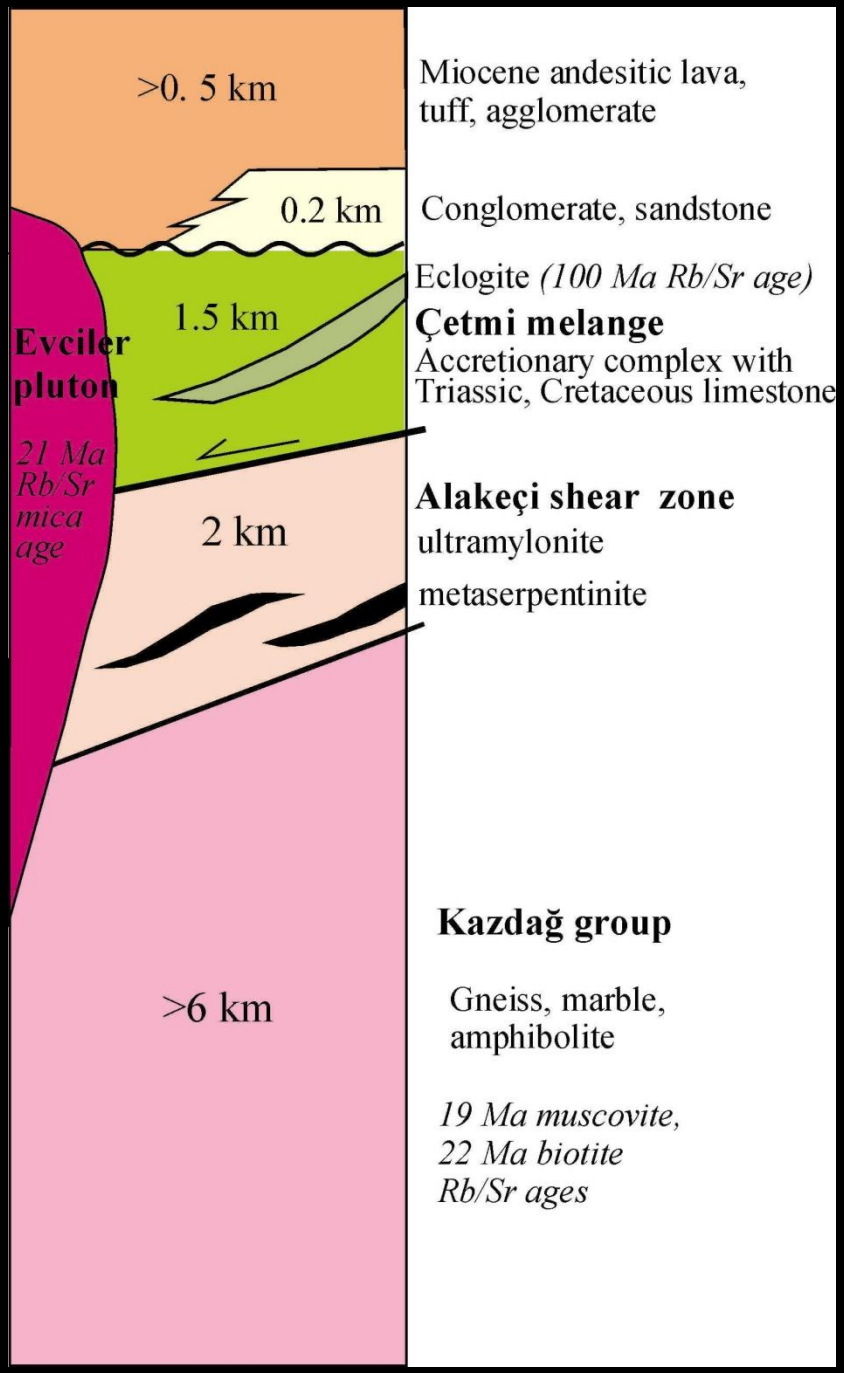




Evciler Granodiyoriti

Oligo-Miyosen magmatizması


A
A'
Alakeçi
Detachment
Uzunalan
Fault
Dalaloba
Serhat
Çetmi
Miocene and younger
Lower Miocene granitoid
Çetmi melange
Triassic limestone
Cretaceous eclogite
Basalt, greywacke, shale, siltstone, chert, limestone, serpentinite
Alakeçi shear zone
Metaserpentinite
Ultramylonite
Kazdag group
Gneiss, marble, amphibolite
N
0 2 4 6 km


>0. 5 km
Miocene andesitic lava, tuff, agglomerate
0.2 km
Conglomerate, sandstone
Eclogite (100 Ma Rb/Sr age)
1.5 km
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2 km
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>6 km
Gneiss, marble, amphibolite
19 Ma muscovite,
22 Ma biotite
Rb/Sr ages





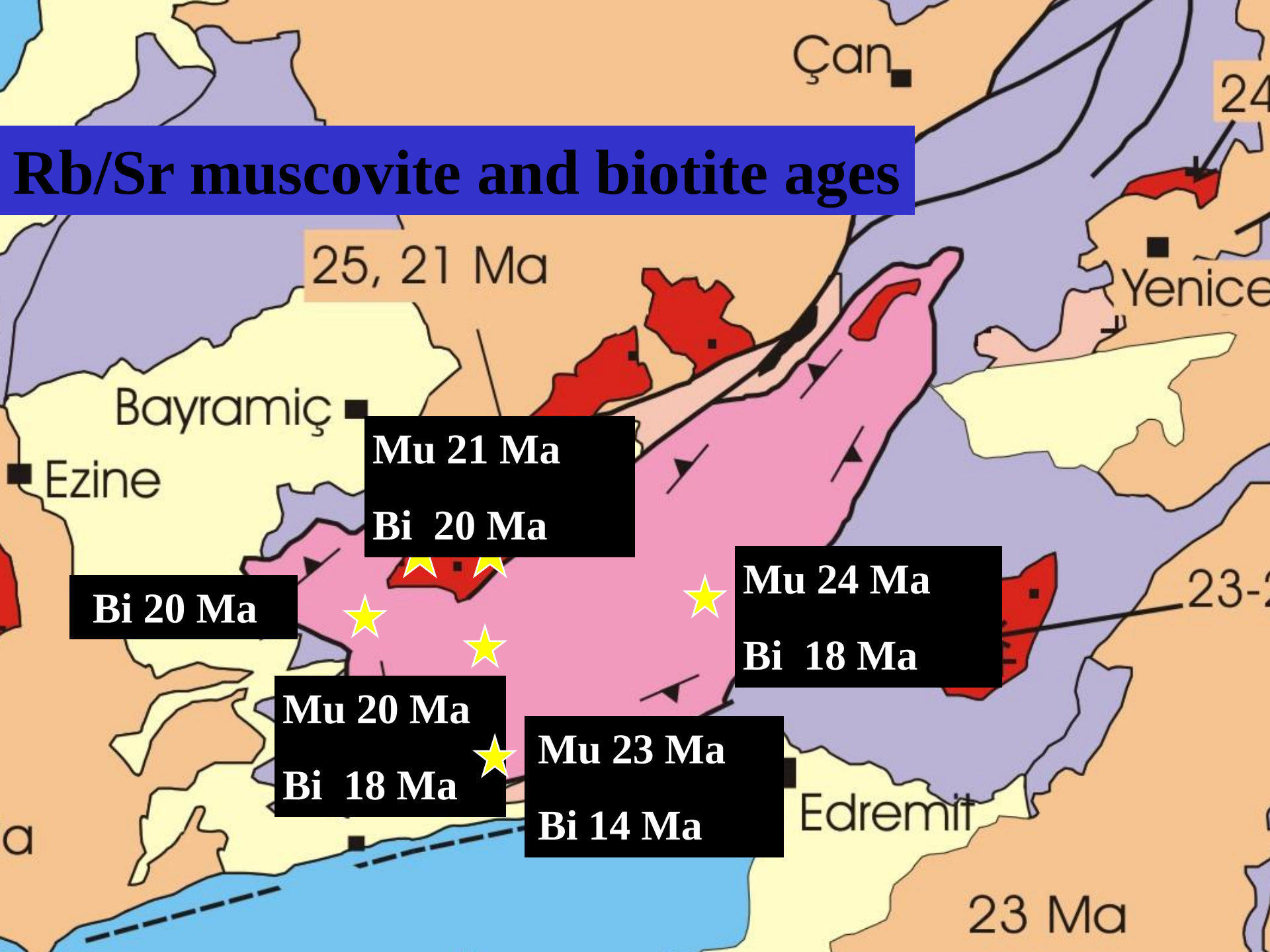

100000

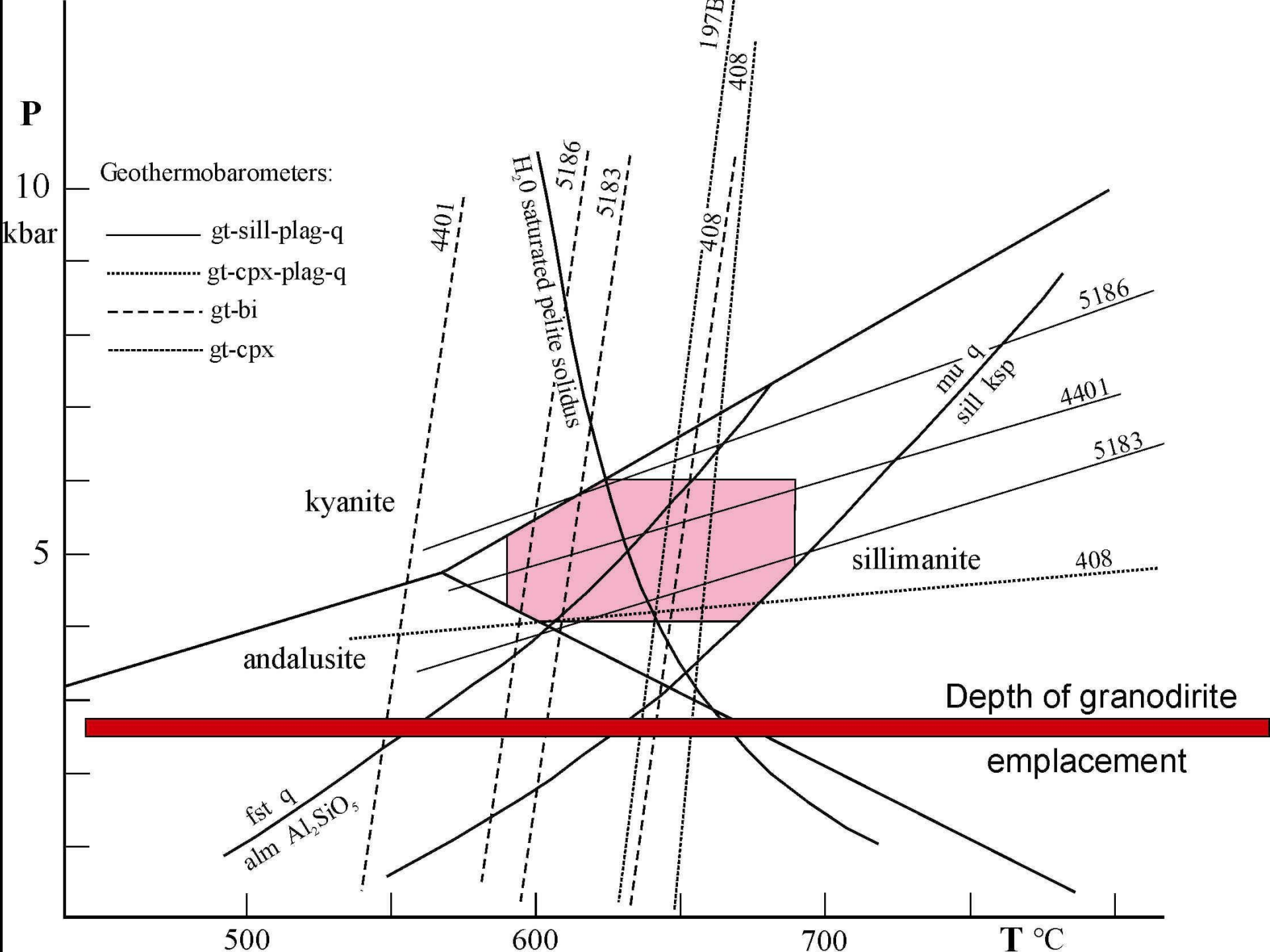


Granodiyoritin yaşının izotopik yöntemle saptanması

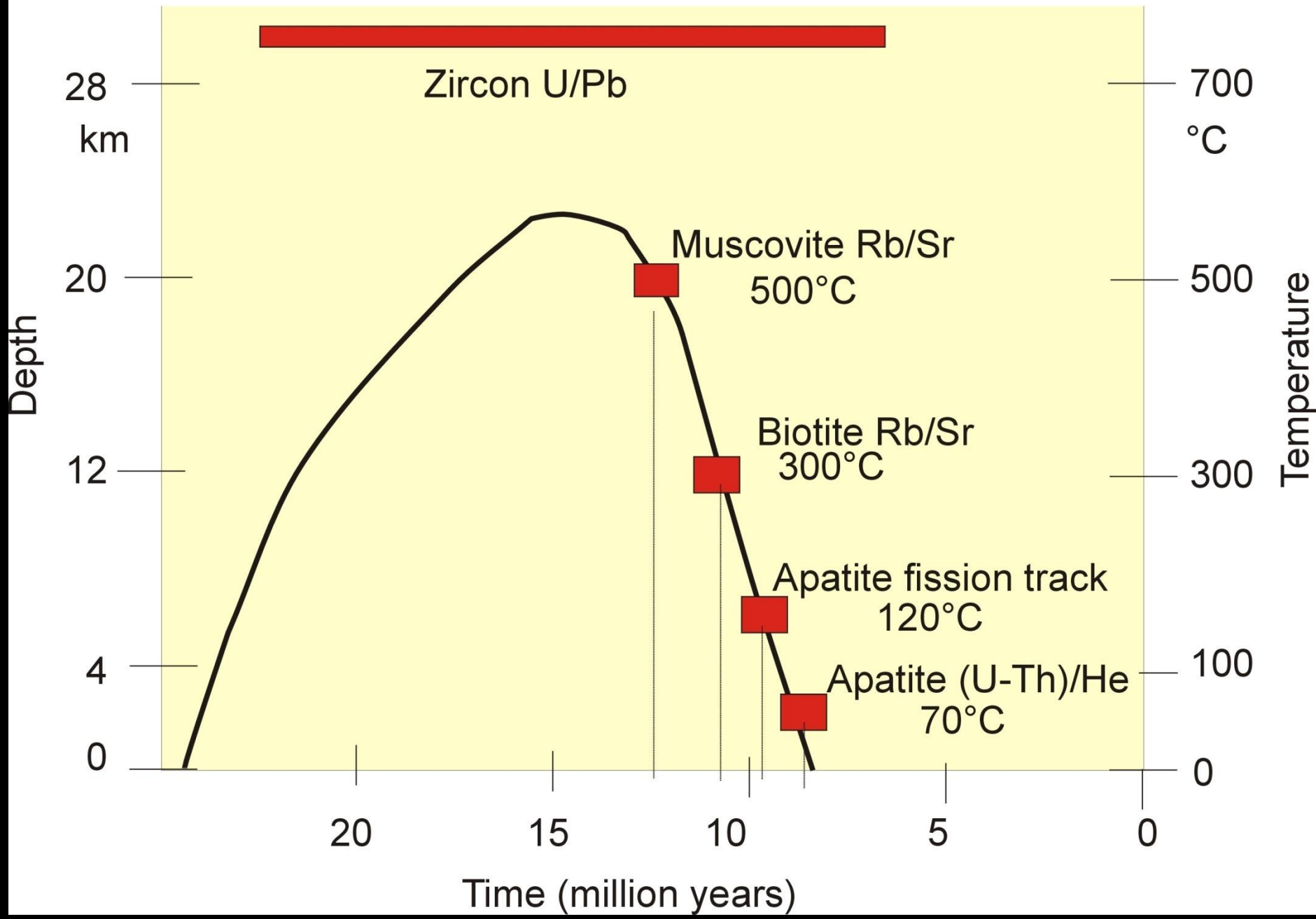
Rb/Sr yöntemi

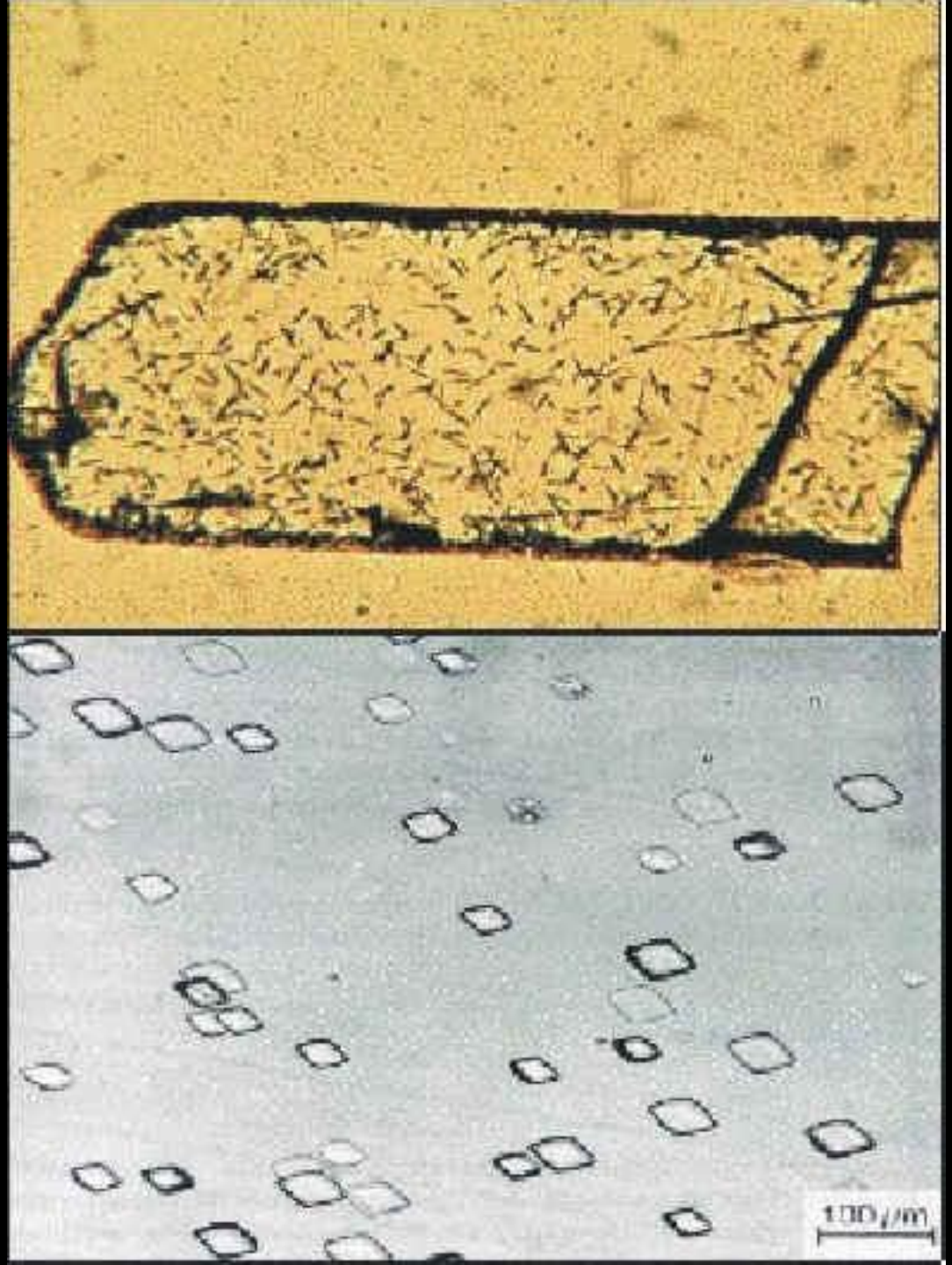
		Evciler granitoid				**Age, Ma**	
5112	rock	59	492	0,35	0,705711		
	biotite	354	6	160	0,752677	**20.7 ± 0.2**	
	cpx	1,9	24,5	0,23	0,705697		
5151	rock	156	463	0,98	0,710112		
	biotite	773	5	456	0,842671	**20.5 ± 0.2**	
	hornblende	11,5	229	0,15	0,709716		
		Kazdağ Gneisses					
average	biotite					**19 ± 1**	
	muscovite					**20 ± 1**	

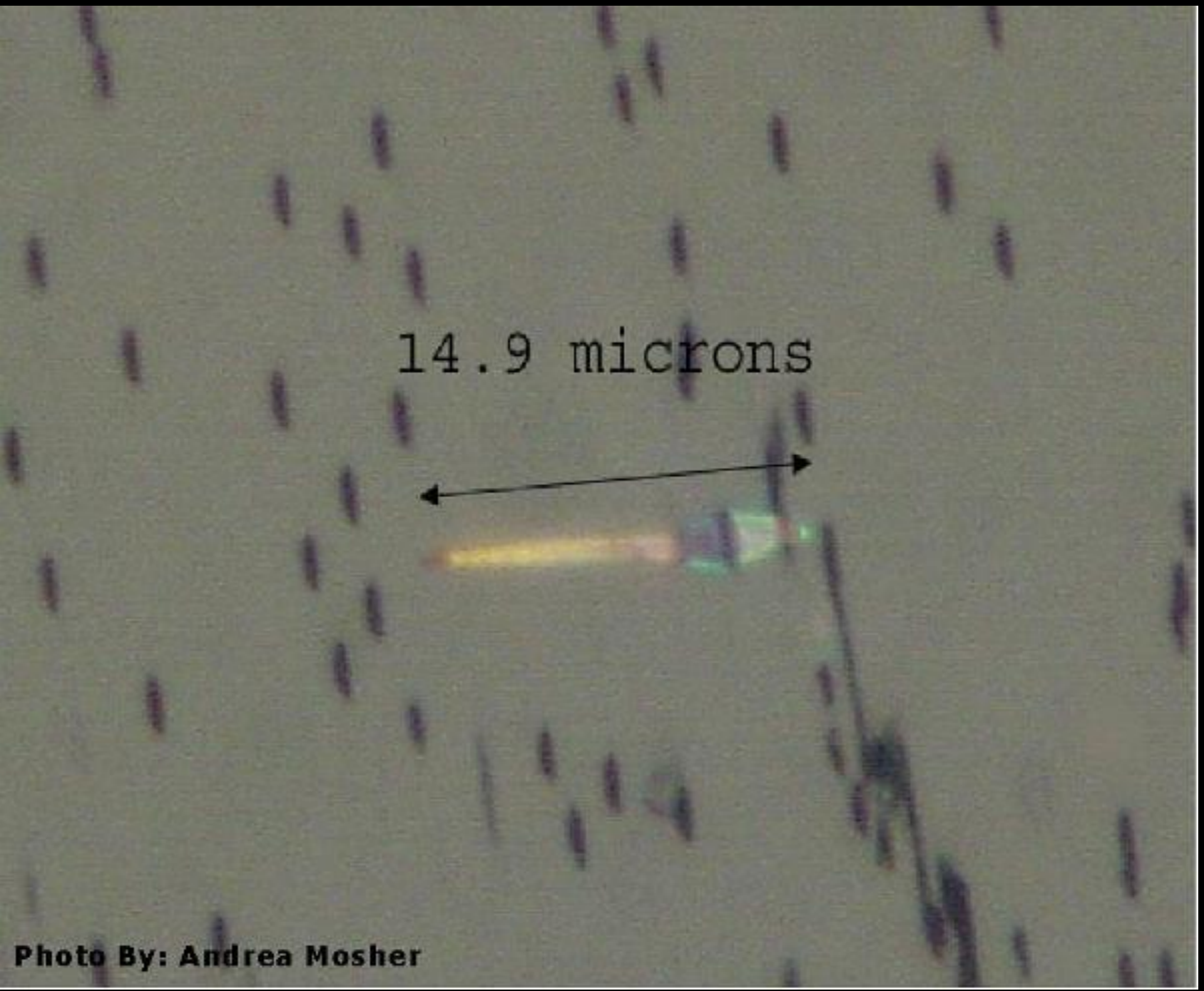

Rb/Sr muscovite and biotite ages
Çan
24
25, 21 Ma
Yenice
Bayramiç
Ezine
Mu 21 Ma
Bi 20 Ma
Bi 20 Ma
Mu 24 Ma
Bi 18 Ma
23-
Mu 20 Ma
Bi 18 Ma
Mu 23 Ma
Bi 14 Ma
Edremit
a
23 Ma

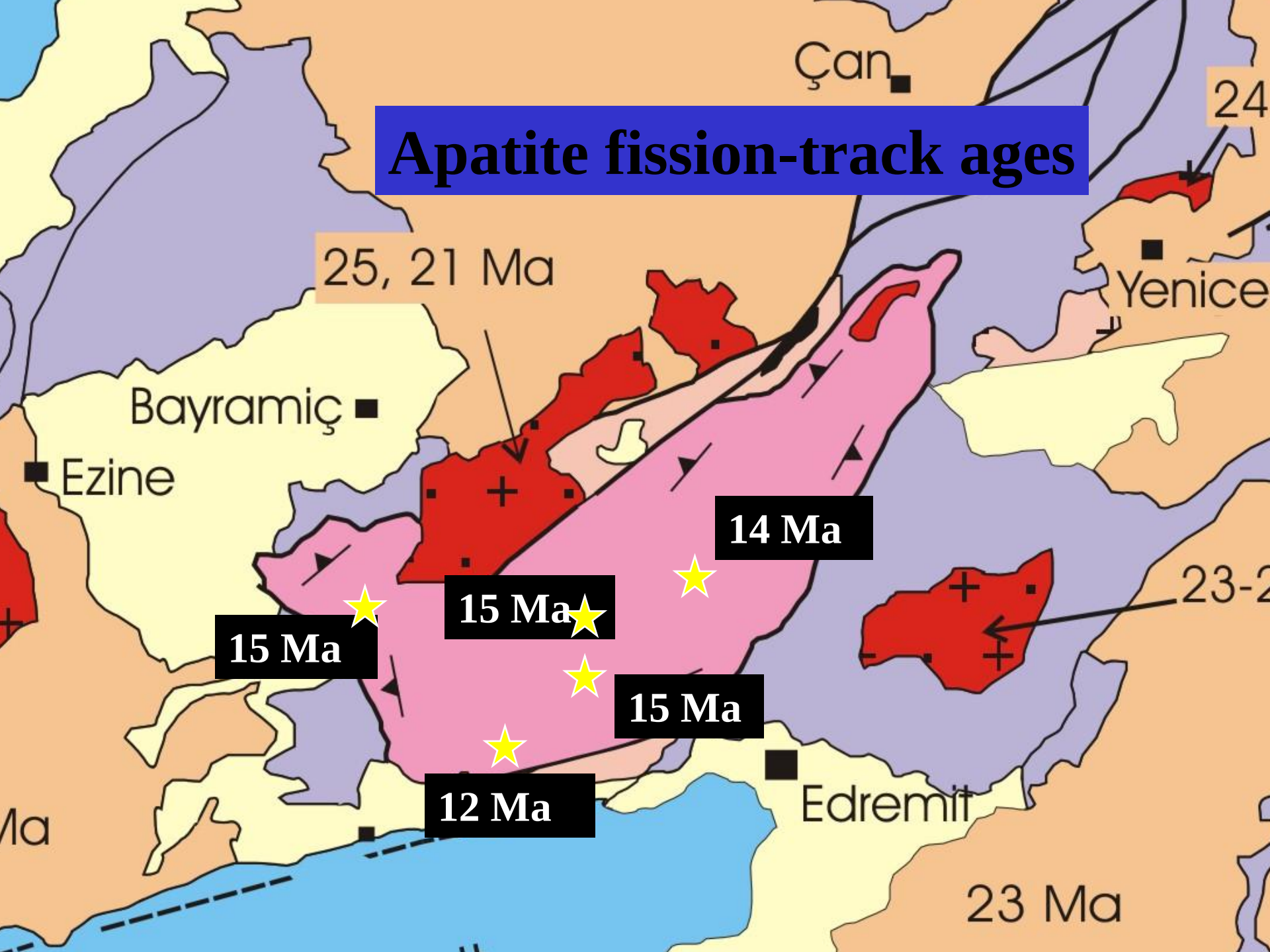

P
10
kbar
5
Geothermobarometers:
gt-sill-plag-q
gt-cpx-plag-q
gt-bi
gt-cpx
4401
H2O saturated pelite solidus
5186
5183
408
197B
408
5186
mu q
sill ksp
4401
5183
kyanite
sillimanite
408
andalusite
Depth of granodirite
emplacement
fst q
alm Al2SiO5
500
600
700
T °C

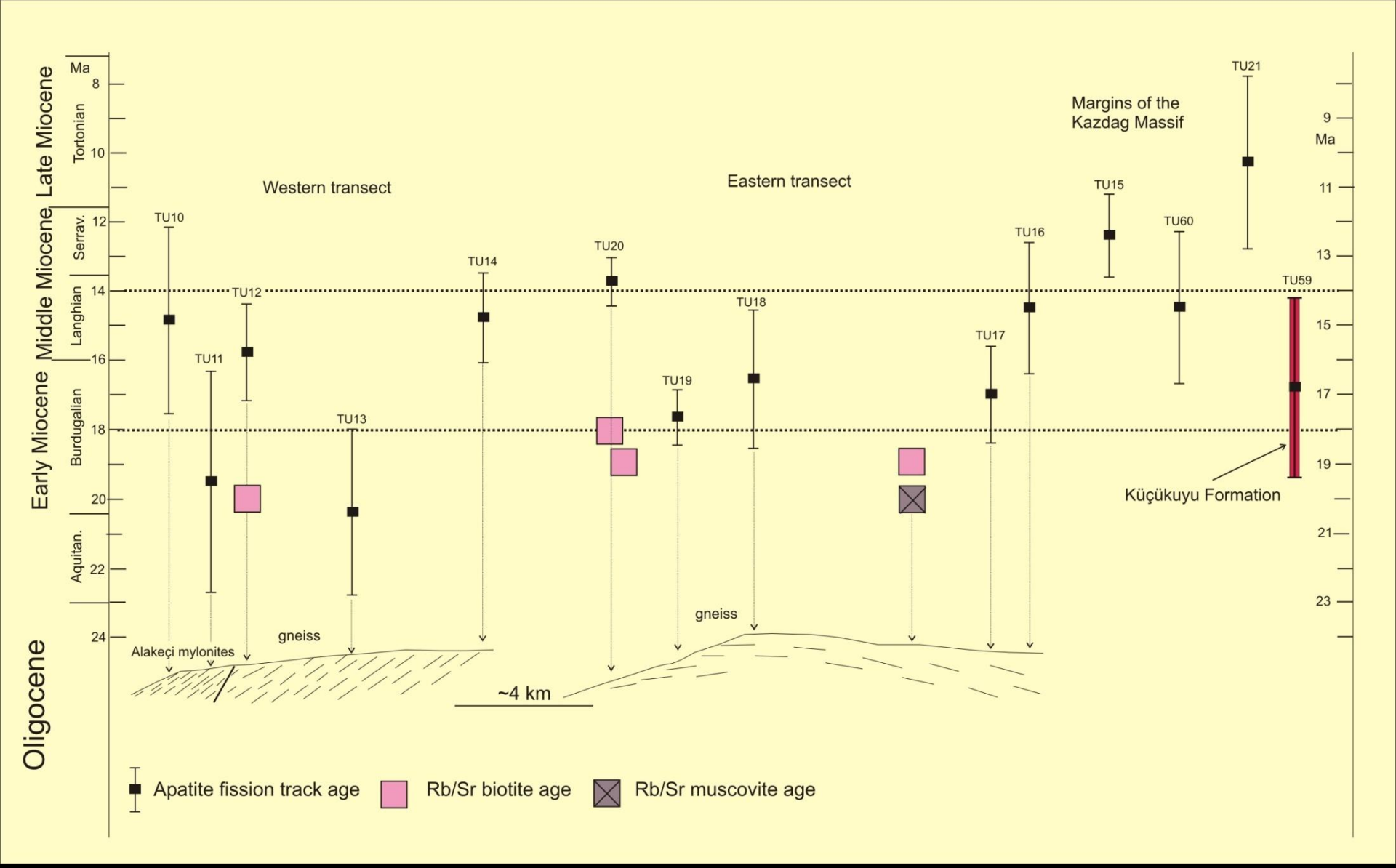
Apatit fizyon iz yaşları

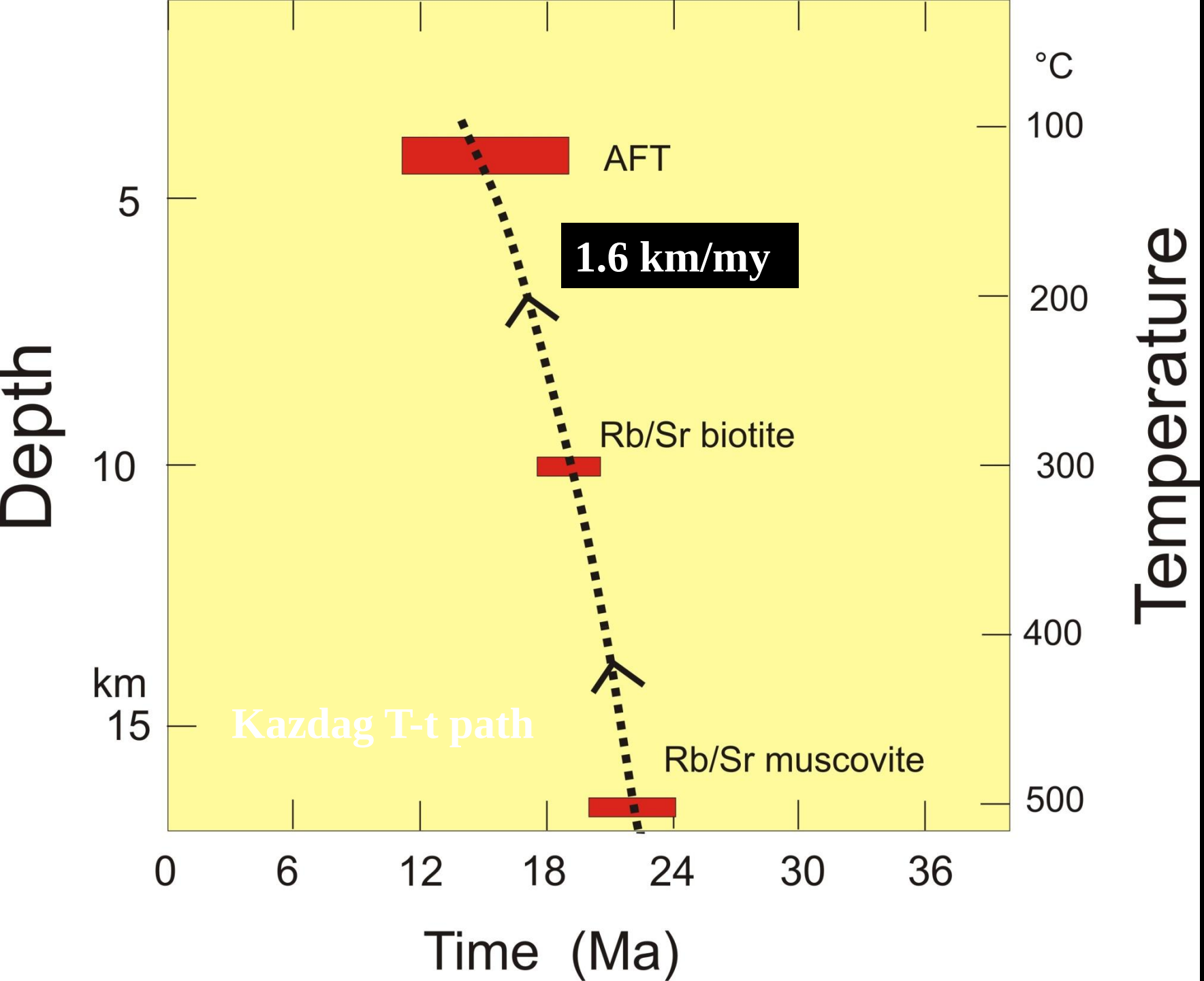

Zircon U/Pb
Muscovite Rb/Sr
500°C
Biotite Rb/Sr
300°C
Apatite fission track
120°C
Apatite (U-Th)/He
70°C
28
km
20
12
4
0
Depth
700
°C
500
300
100
0
Temperature
20
15
10
5
0
Time (million years)

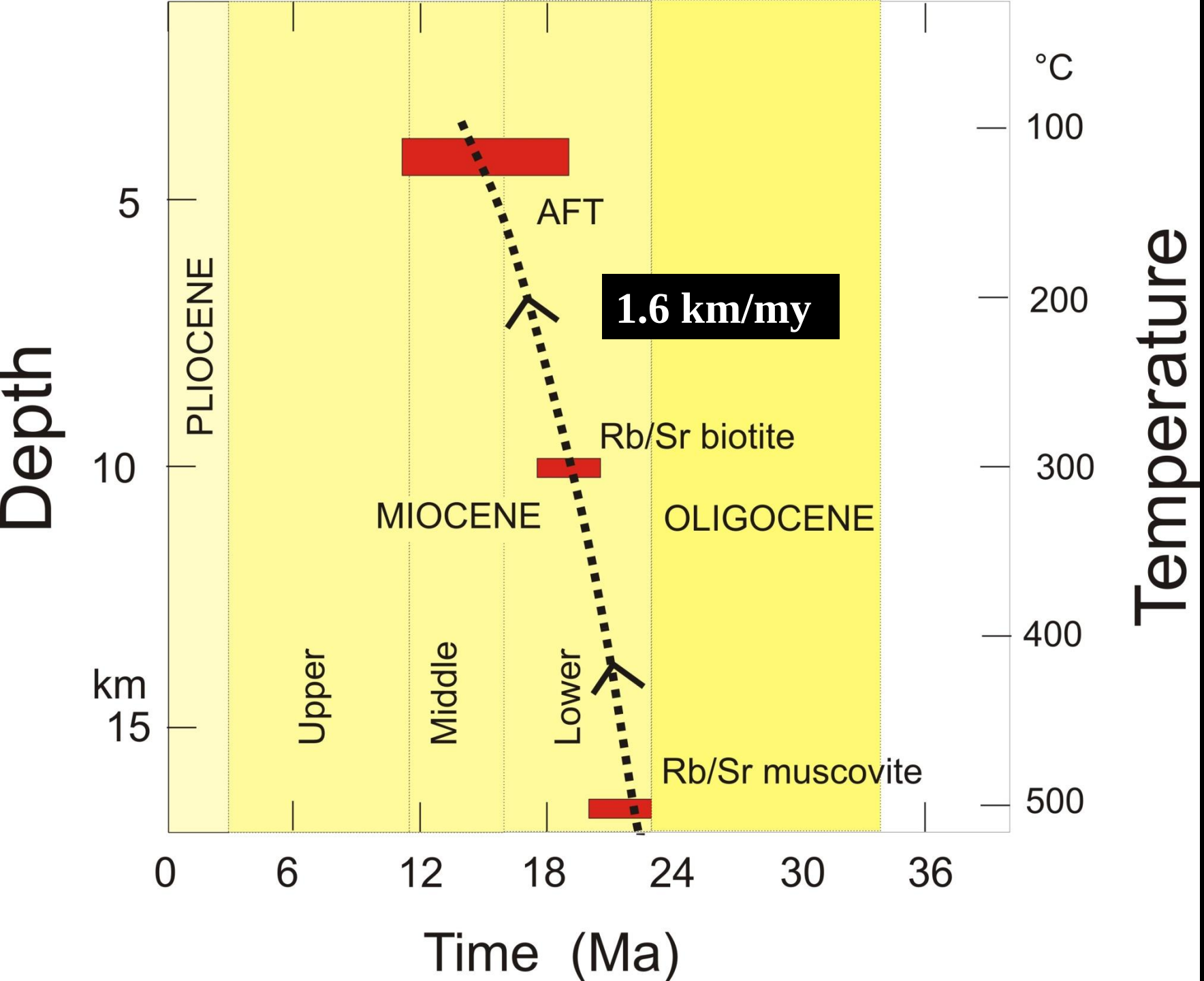

100 μm


14.9 microns
Photo By: Andrea Mosher

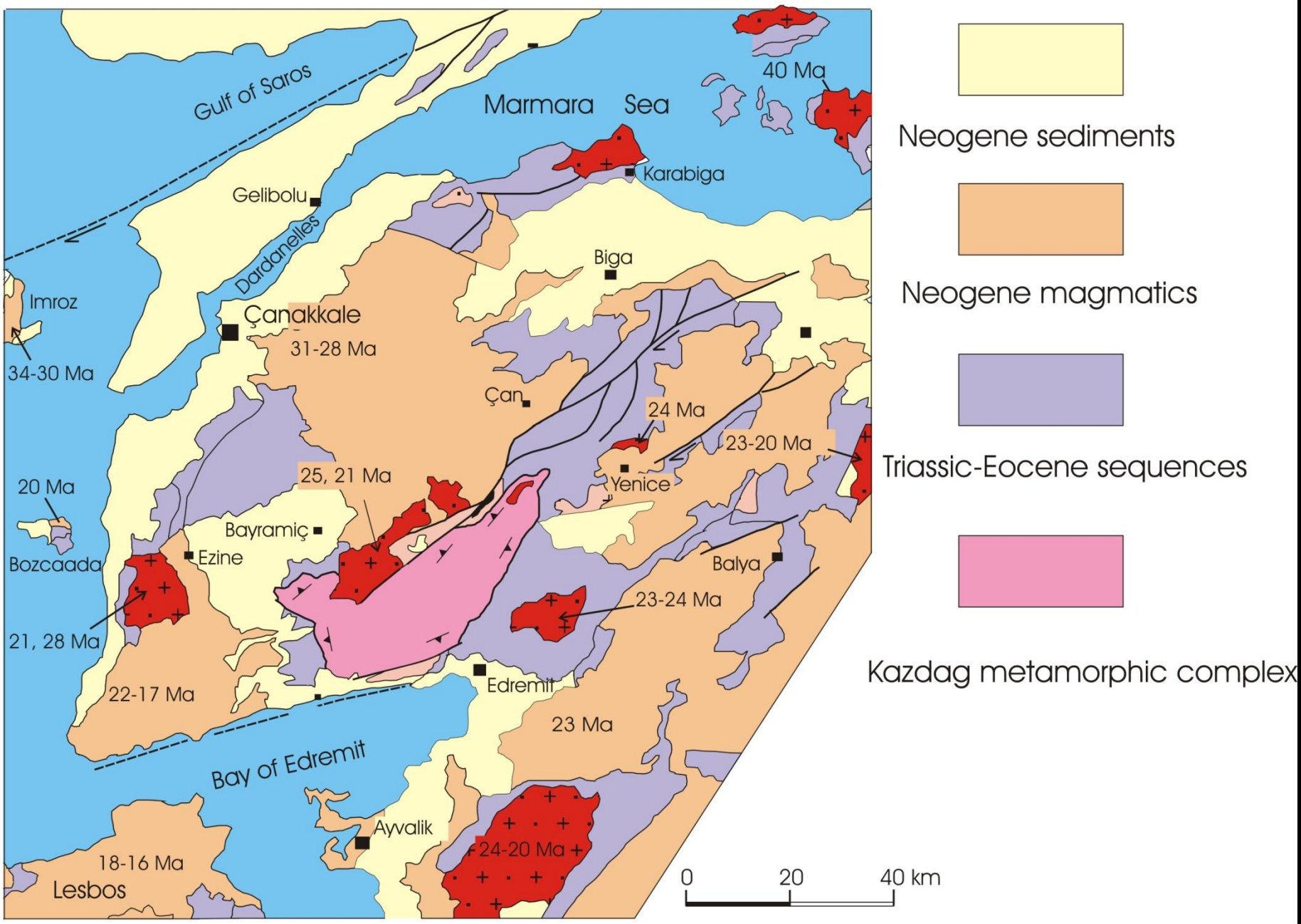

Apatite fission-track ages
Çan
24
25, 21 Ma
Yenice
Bayramiç
Ezine
14 Ma
15 Ma
15 Ma
15 Ma
12 Ma
Edremit
23 Ma

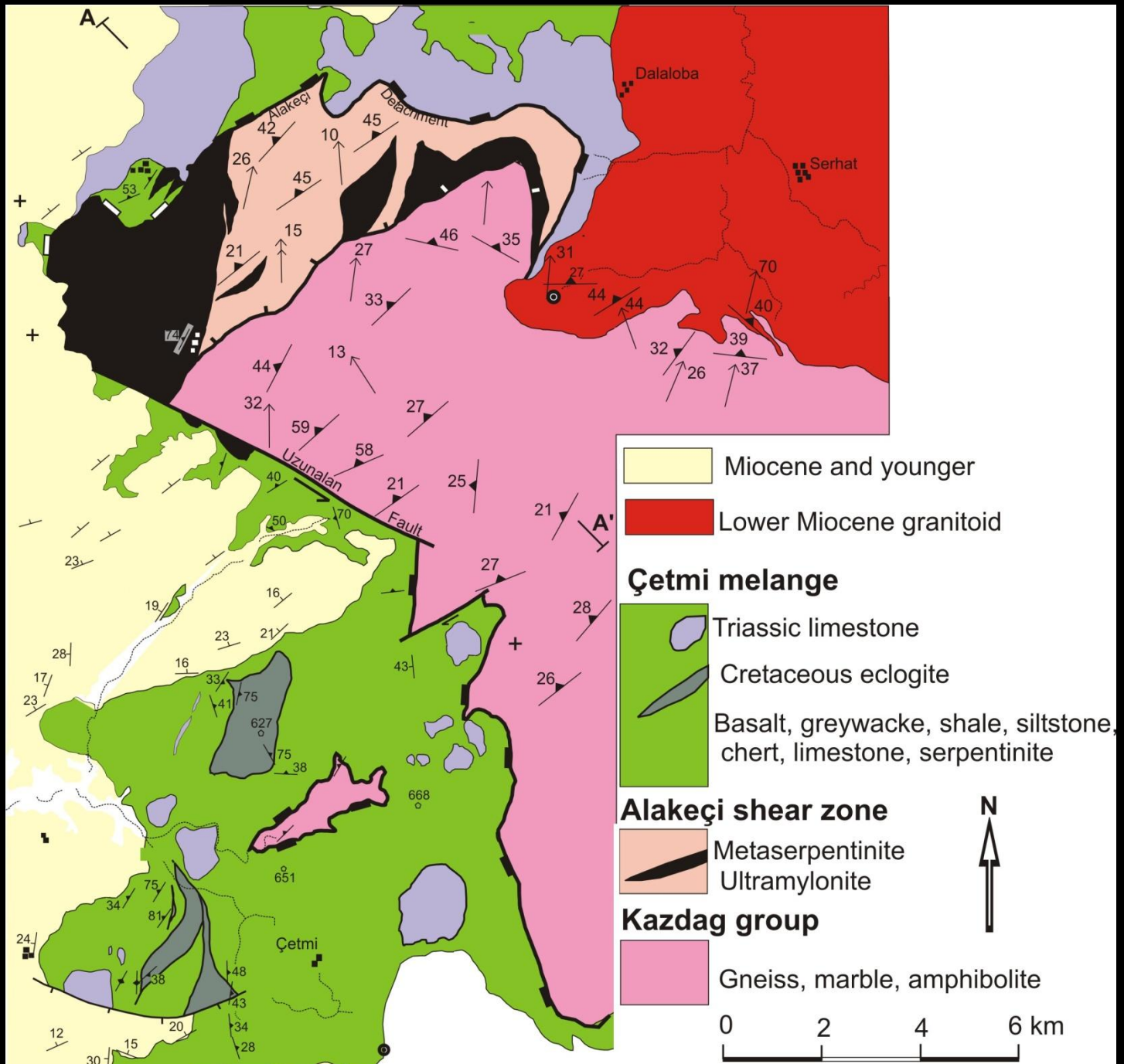

Ma
Late Miocene
Middle Miocene
Early Miocene
Oligocene
Tortonian
Serrav.
Langhian
Burdugalian
Aquitan.
8
10
12
14
16
18
20
22
24
Western transect
Eastern transect
Margins of the
Kazdag Massif
TU10
TU11
TU12
TU13
TU14
TU20
TU19
TU18
TU17
TU16
TU15
TU60
TU21
TU59
Küçükuyu Formation
Alakeçi mylonites
gneiss
gneiss
~4 km
9
11
13
15
17
19
21
23
Apatite fission track age
Rb/Sr biotite age
Rb/Sr muscovite age

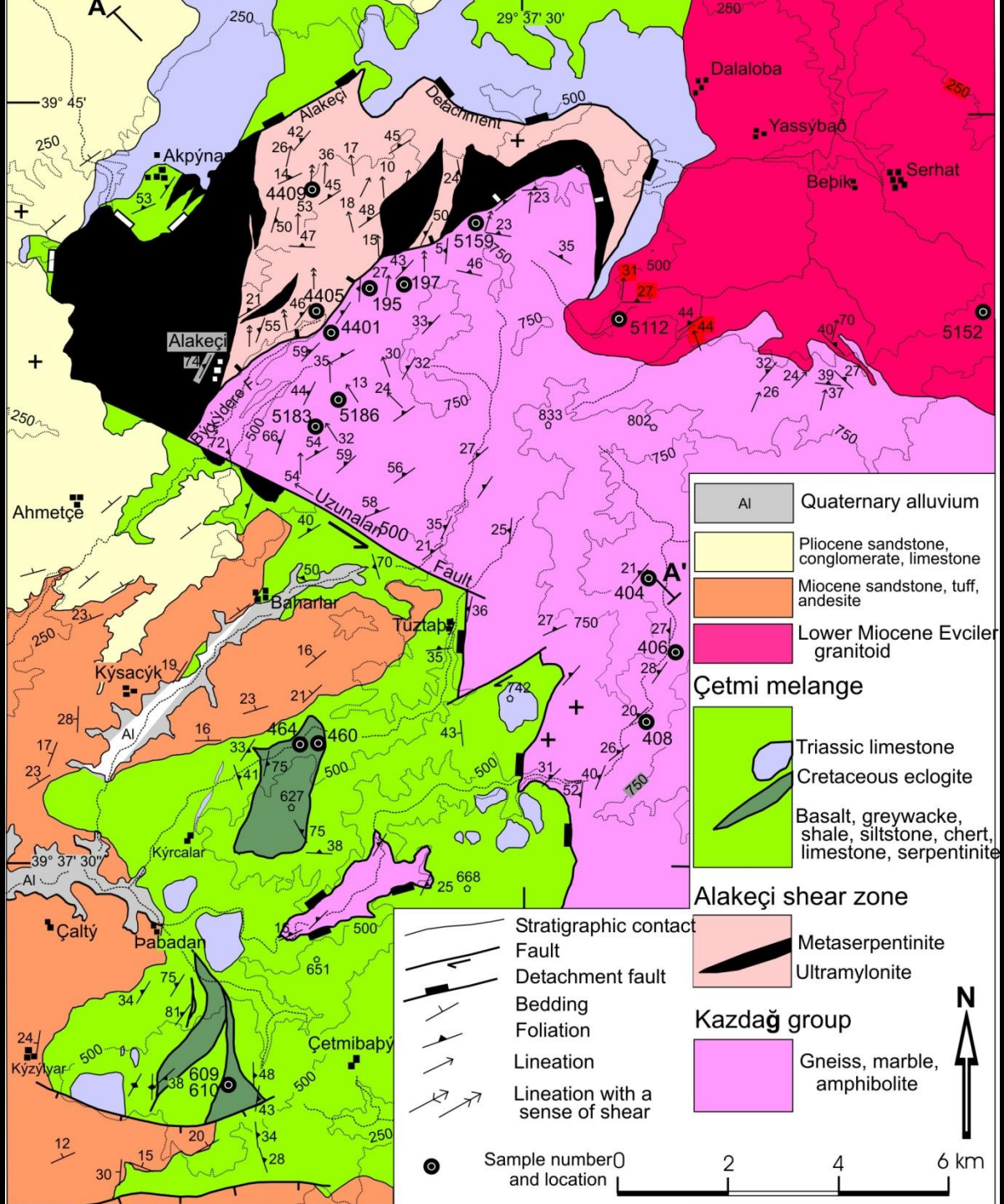

°C
100
200
300
400
500
Temperature
AFT
1.6 km/my
Rb/Sr biotite
Rb/Sr muscovite
Kazdag T-t path
Depth
5
10
km
15
0
6
12
18
24
30
36
Time (Ma)

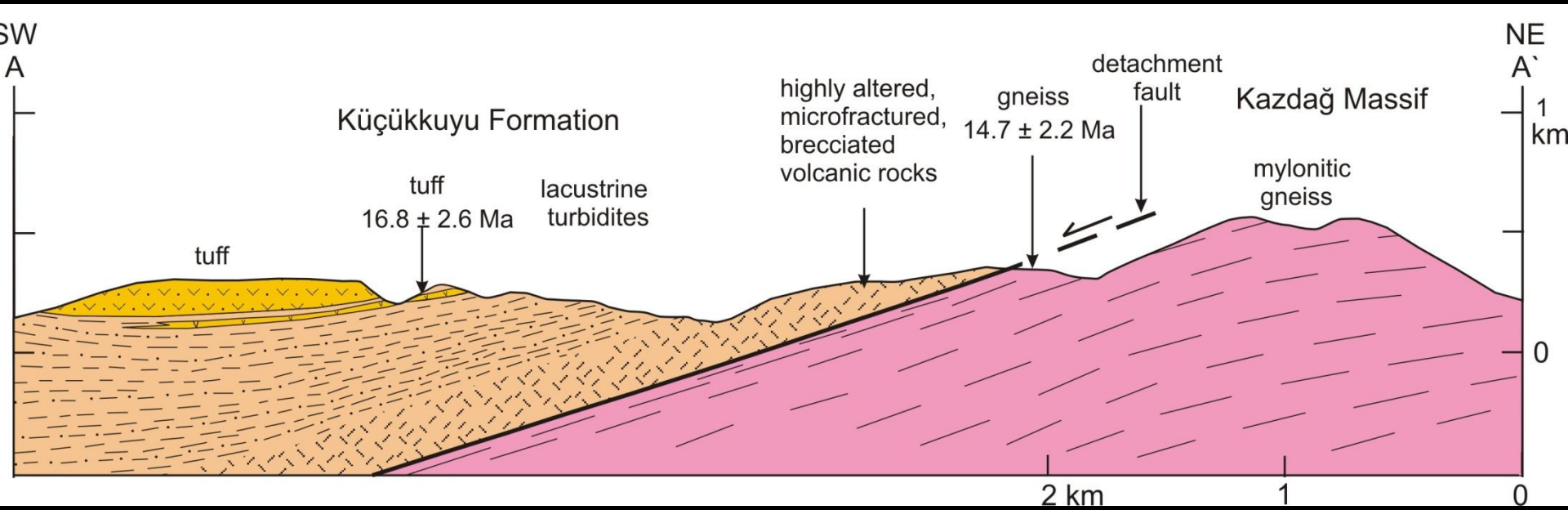

Depth
km
5
10
15
PLIOCENE
MIOCENE
OLIGOCENE
Upper
Middle
Lower
AFT
1.6 km/my
Rb/Sr biotite
Rb/Sr muscovite
°C
100
200
300
400
500
Temperature
0
6
12
18
24
30
36
Time (Ma)

Küçükkuyu Formasyonu sıyrılma fayı havzası


Gulf of Saros
Marmara Sea
40 Ma
Karabiga
Gelibolu
Dardanelles
Biga
Imroz
Çanakkale
31-28 Ma
34-30 Ma
Çan
24 Ma
23-20 Ma
Yenice
25, 21 Ma
20 Ma
Bayramiç
Ezine
Bozcaada
Balya
23-24 Ma
21, 28 Ma
Edremit
22-17 Ma
23 Ma
Bay of Edremit
Ayvalik
24-20 Ma
18-16 Ma
Lesbos
0
20
40 km
Neogene sediments
Neogene magmatics
Triassic-Eocene sequences
Kazdag metamorphic complex

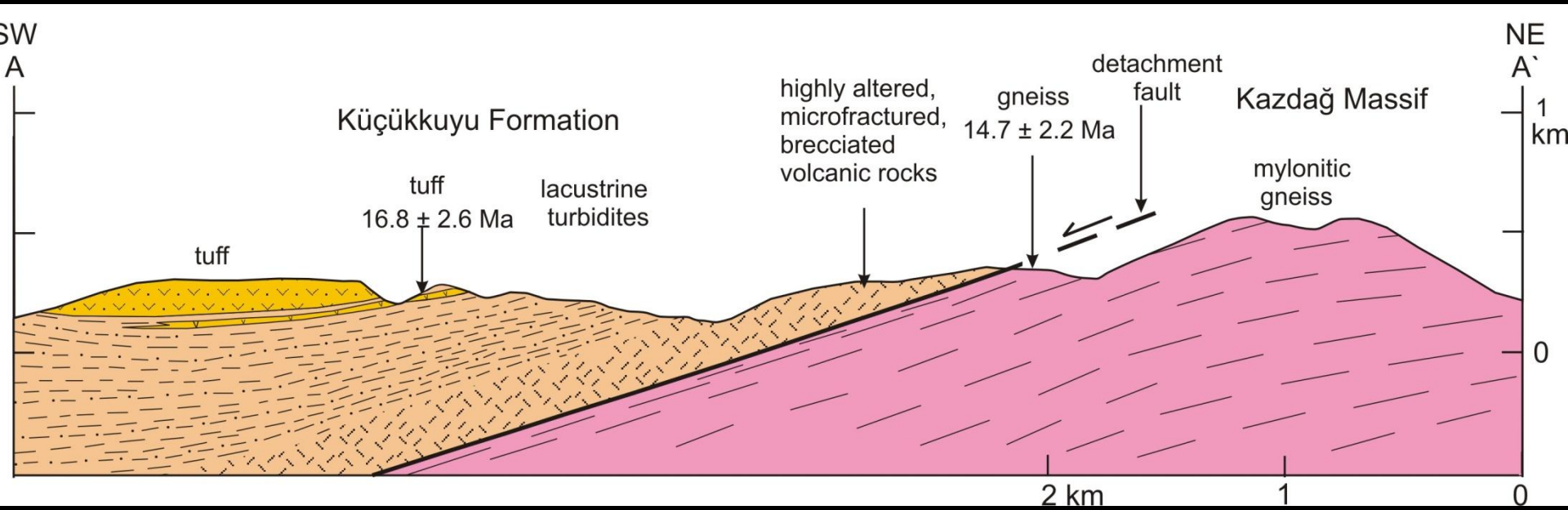

A
A'
Alakeçi
Detachment
Uzunalan
Fault
Dalaloba
Serhat
Çetmi
Miocene and younger
Lower Miocene granitoid
Çetmi melange
Triassic limestone
Cretaceous eclogite
Basalt, greywacke, shale, siltstone, chert, limestone, serpentinite
Alakeçi shear zone
Metaserpentinite
Ultramylonite
Kazdag group
Gneiss, marble, amphibolite
N
0 2 4 6 km


A
A'
29° 37' 30"
39° 45'
39° 37' 30"
Dalaloba
Yassýbaõ
Serhat
Beþik
Akpýnar
Alakeçi
Detachment
Alakeçi
Ahmetçe
Baharlar
Tüztaþý
Kýsacýk
Kýrcalar
Çaltý
Þabadan
Çetmibaþý
Kýzýlyar
Uzunalan Fault
Al
Quaternary alluvium
Pliocene sandstone, conglomerate, limestone
Miocene sandstone, tuff, andesite
Lower Miocene Evciler granitoid
Çetmi melange
Triassic limestone
Cretaceous eclogite
Basalt, greywacke, shale, siltstone, chert, limestone, serpentinite
Alakeçi shear zone
Metaserpentinite
Ultramylonite
Kazdağ group
Gneiss, marble, amphibolite
Stratigraphic contact
Fault
Detachment fault
Bedding
Foliation
Lineation
Lineation with a sense of shear
Sample number and location
N
0
2
4
6 km


SW
A
NE
A`
Küçükkuyu Formation
tuff
16.8 ± 2.6 Ma
lacustrine
turbidites
tuff
highly altered,
microfractured,
brecciated
volcanic rocks
gneiss
14.7 ± 2.2 Ma
detachment
fault
Kazdağ Massif
mylonitic
gneiss
1
km
0
2 km
1
0



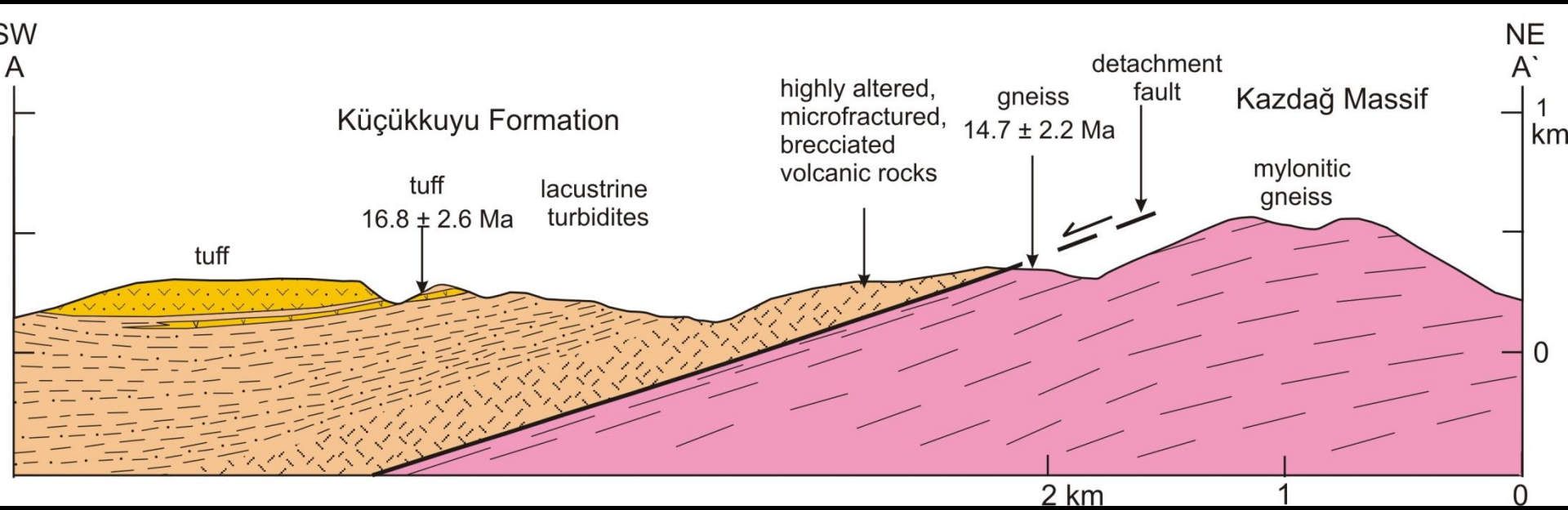



SW
A
NE
A`
Küçükkuyu Formation
tuff
16.8 ± 2.6 Ma
lacustrine
turbidites
tuff
highly altered,
microfractured,
brecciated
volcanic rocks
gneiss
14.7 ± 2.2 Ma
detachment
fault
Kazdağ Massif
mylonitic
gneiss
1
km
0
2 km
1
0

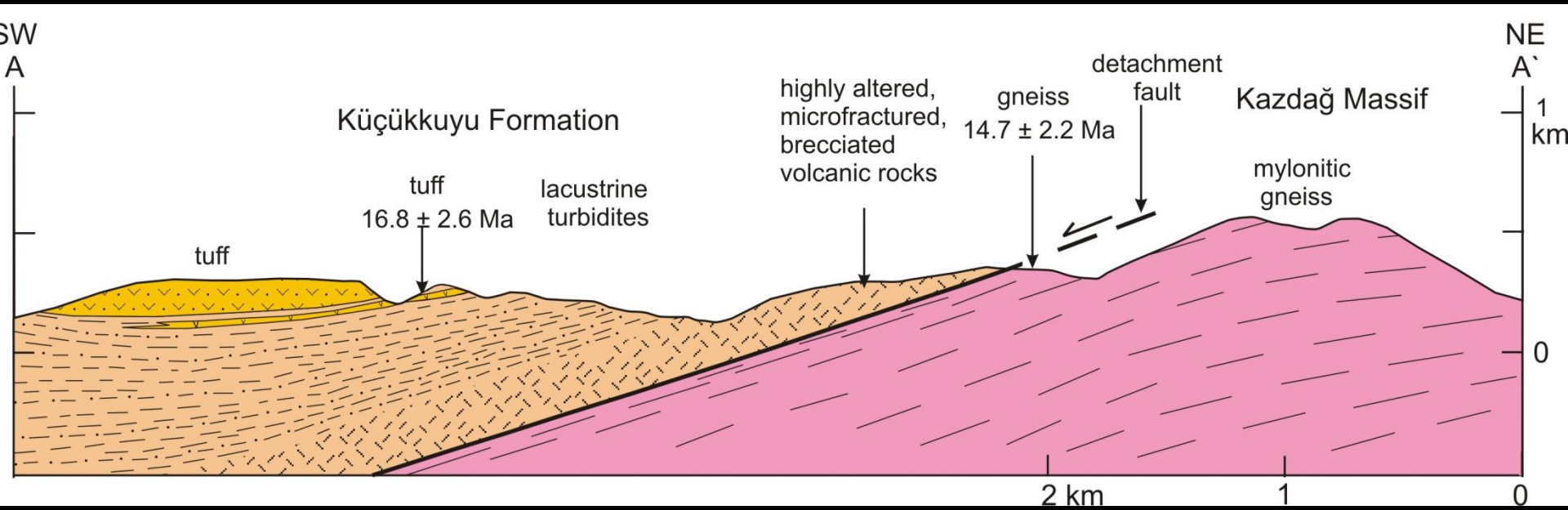


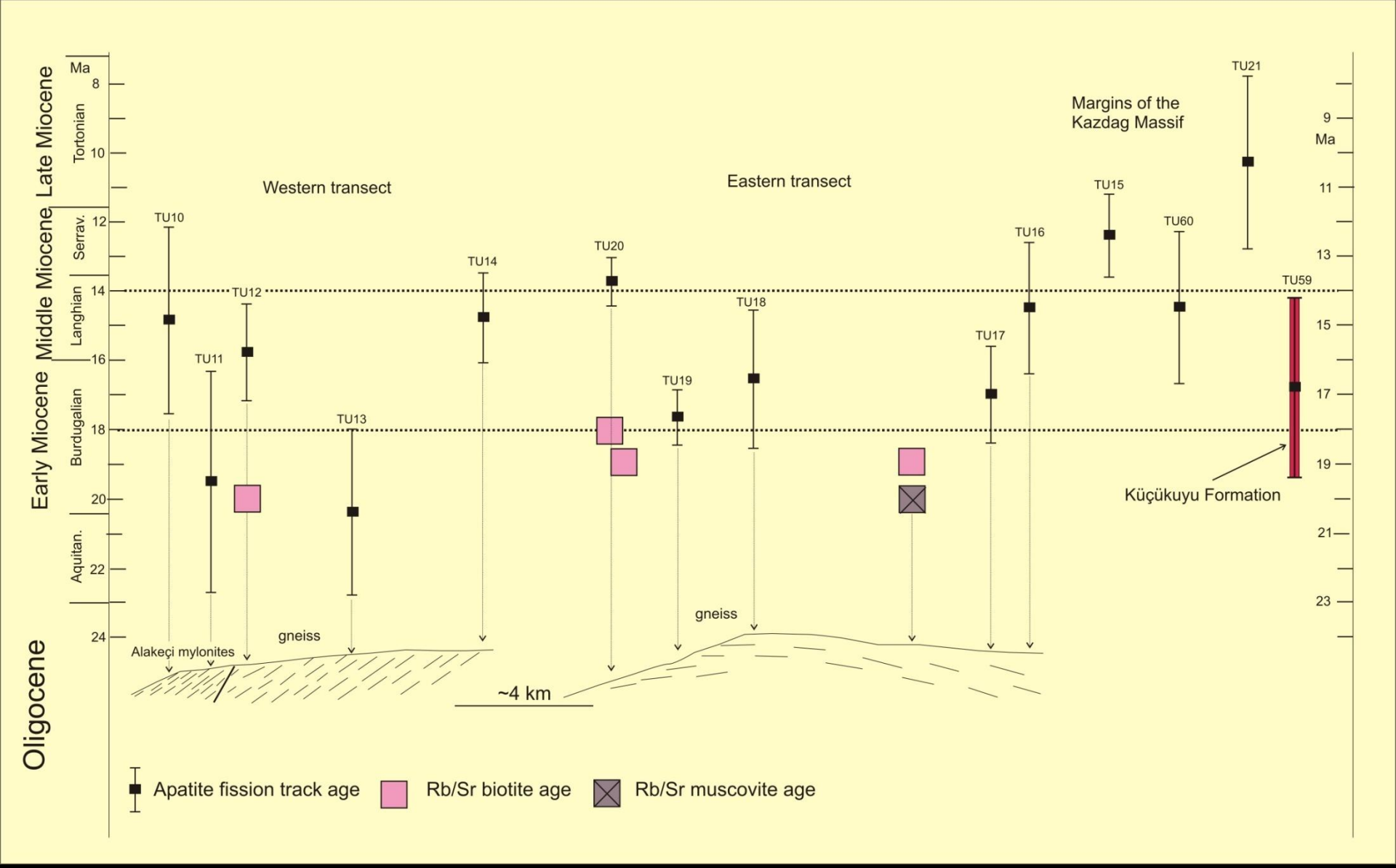


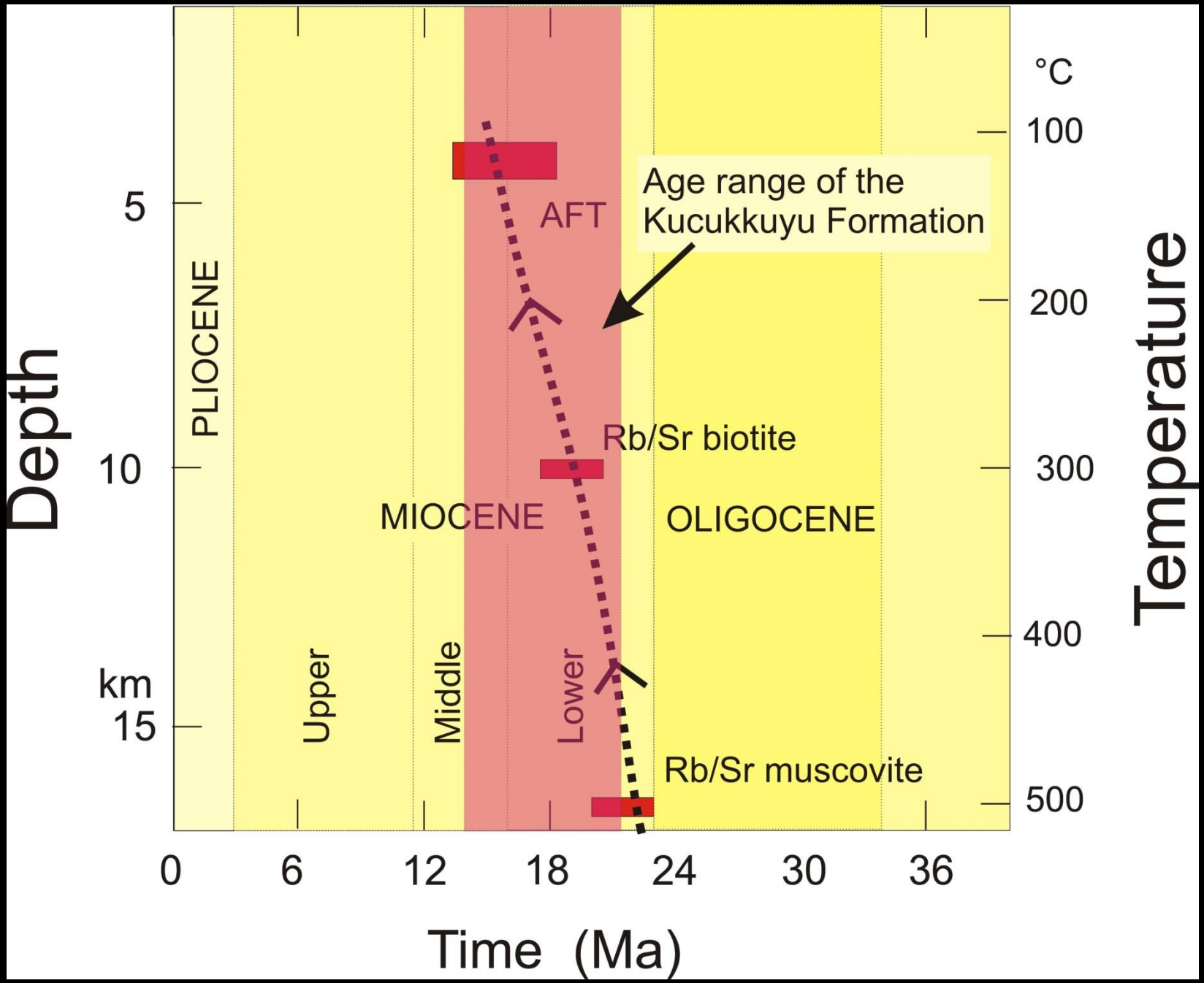


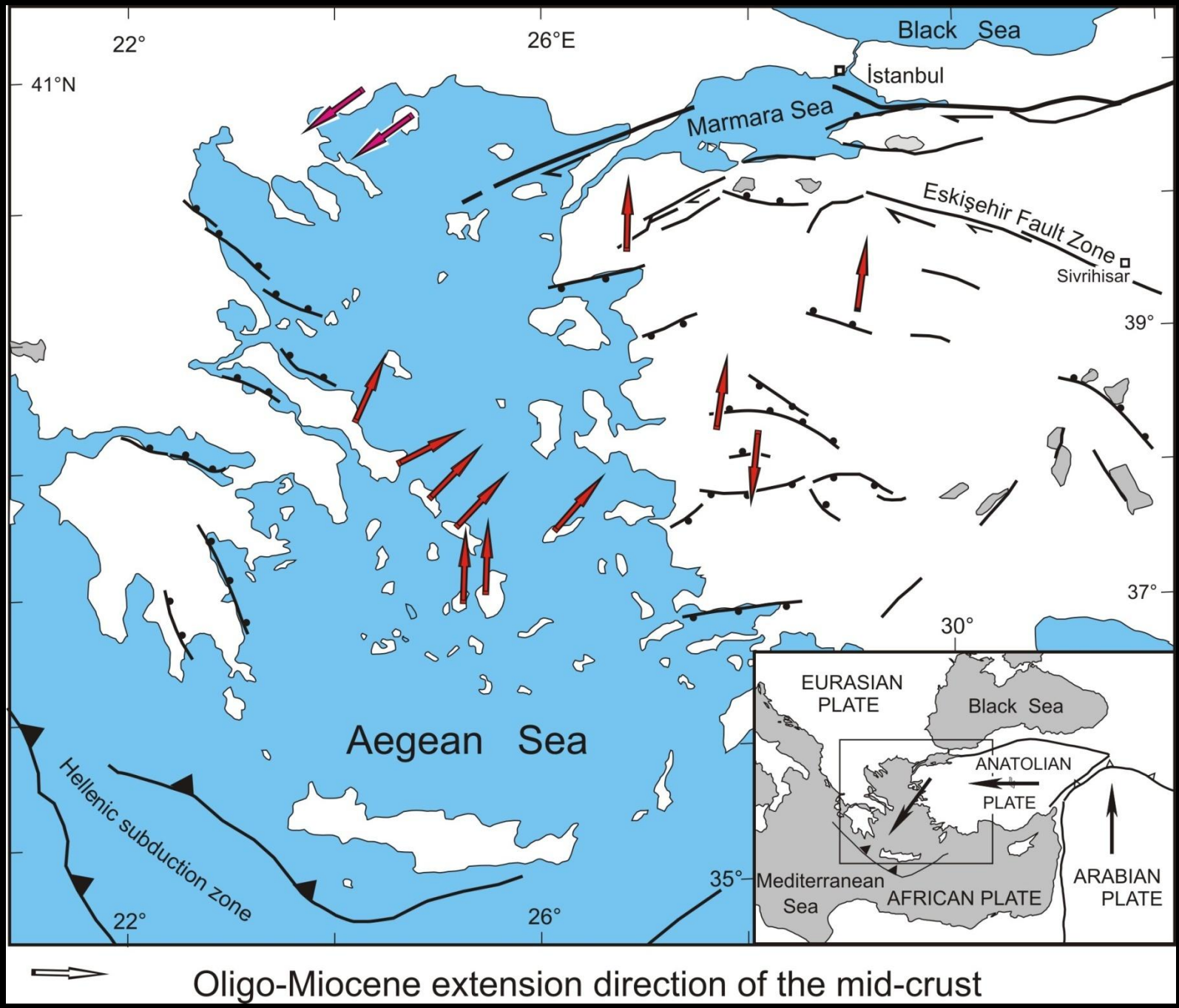

SW
A
NE
A`
Küçükkuyu Formation
tuff
16.8 ± 2.6 Ma
lacustrine
turbidites
tuff
highly altered,
microfractured,
brecciated
volcanic rocks
gneiss
14.7 ± 2.2 Ma
detachment
fault
Kazdağ Massif
mylonitic
gneiss
1
km
0
2 km
1
0

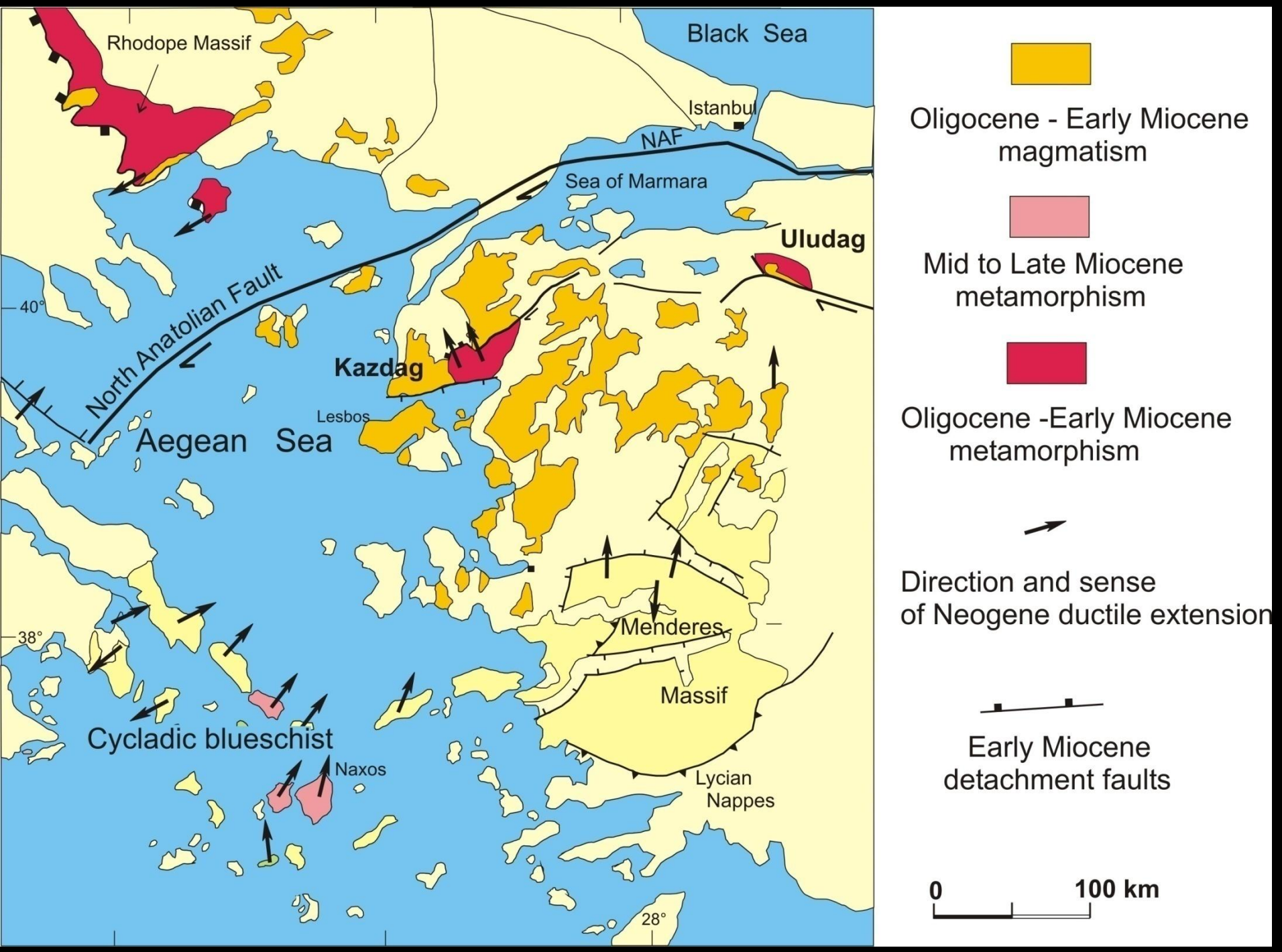


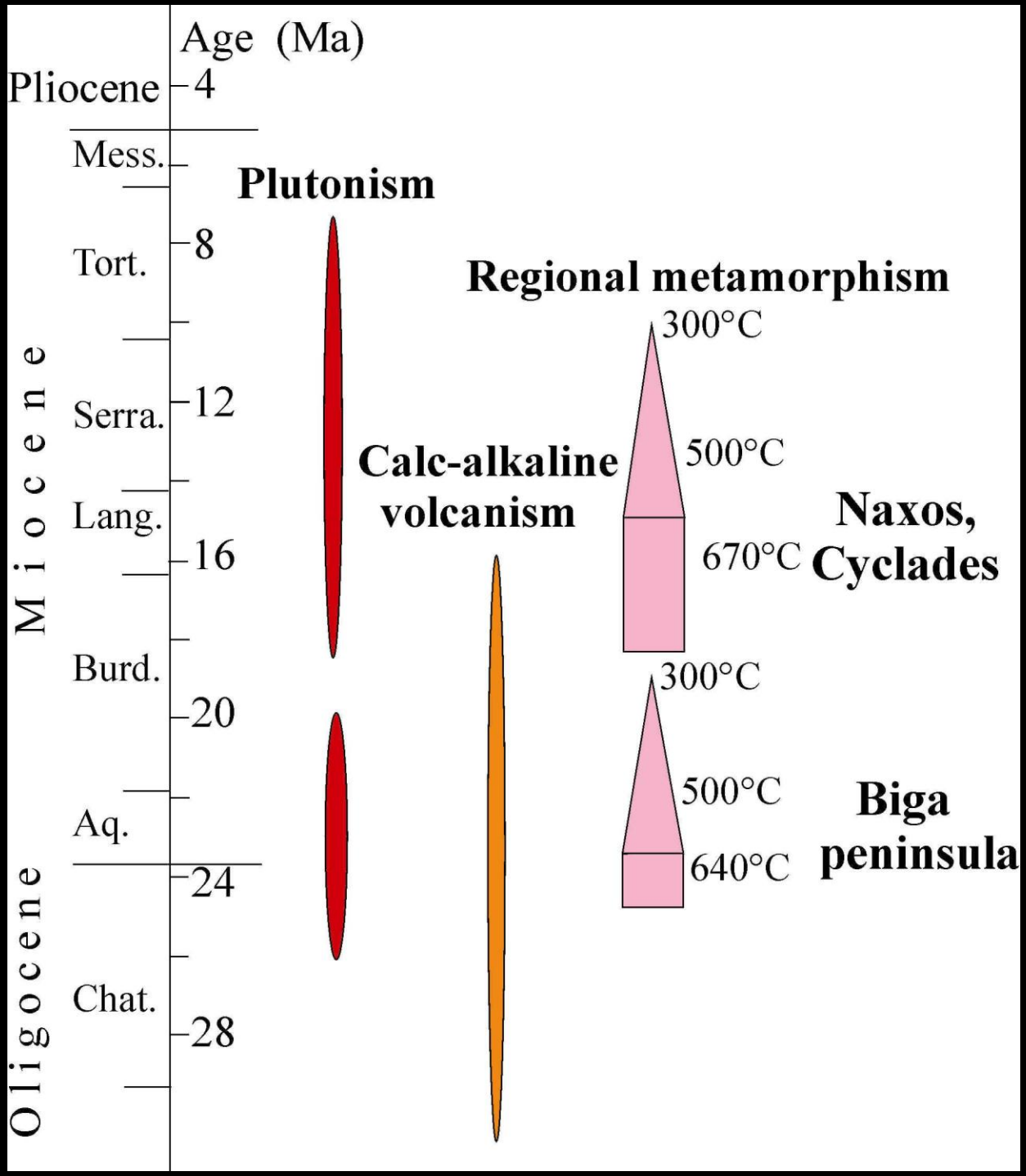

SW
A
NE
A`
Küçükkuyu Formation
tuff
16.8 ± 2.6 Ma
lacustrine
turbidites
tuff
highly altered,
microfractured,
brecciated
volcanic rocks
gneiss
14.7 ± 2.2 Ma
detachment
fault
Kazdağ Massif
mylonitic
gneiss
1
km
0
2 km
1
0


Ma
Late Miocene
Middle Miocene
Early Miocene
Oligocene
Tortonian
Serrav.
Langhian
Burdugalian
Aquitan.
8
10
12
14
16
18
20
22
24
Western transect
Eastern transect
Margins of the
Kazdag Massif
TU10
TU11
TU12
TU13
TU14
TU20
TU19
TU18
TU17
TU16
TU15
TU60
TU21
TU59
Küçükuyu Formation
Alakeçi mylonites
gneiss
gneiss
~4 km
9
11
13
15
17
19
21
23
Apatite fission track age
Rb/Sr biotite age
Rb/Sr muscovite age


Depth
km
5
10
15
PLIOCENE
MIOCENE
OLIGOCENE
Upper
Middle
Lower
AFT
Rb/Sr biotite
Rb/Sr muscovite
Age range of the
Kucukkuyu Formation
0
6
12
18
24
30
36
Time (Ma)
°C
100
200
300
400
500
Temperature


22°
26°E
41°N
Black Sea
İstanbul
Marmara Sea
Eskişehir Fault Zone
Sivrihisar
39°
37°
30°
Aegean Sea
Hellenic subduction zone
22°
26°
35°
EURASIAN PLATE
Black Sea
ANATOLIAN PLATE
Mediterranean Sea
AFRICAN PLATE
ARABIAN PLATE
Oligo-Miocene extension direction of the mid-crust


Rhodope Massif
Black Sea
Istanbul
NAF
Sea of Marmara
Uludag
North Anatolian Fault
40°
Kazdag
Lesbos
Aegean Sea
38°
Menderes
Massif
Cycladic blueschist
Naxos
Lycian
Nappes
28°
Oligocene - Early Miocene
magmatism
Mid to Late Miocene
metamorphism
Oligocene -Early Miocene
metamorphism
Direction and sense
of Neogene ductile extension
Early Miocene
detachment faults
0
100 km


Age (Ma)
Pliocene
4
Mess.
Plutonism
Tort.
8
Regional metamorphism
300°C
Miocene
Serra.
12
500°C
Calc-alkaline
volcanism
Lang.
Naxos,
Cyclades
16
670°C
Burd.
300°C
20
500°C
Biga
peninsula
Aq.
640°C
24
Oligocene
Chat.
28

Sonuçlar

En Geç Oligosen ve Erken Miyosen'de (24-20 Ma) kuzeybatı Anadolu'nun orta ve alt kabuğunda kuzey-güney yönlü genişleme tektoniği meydana geliyor.

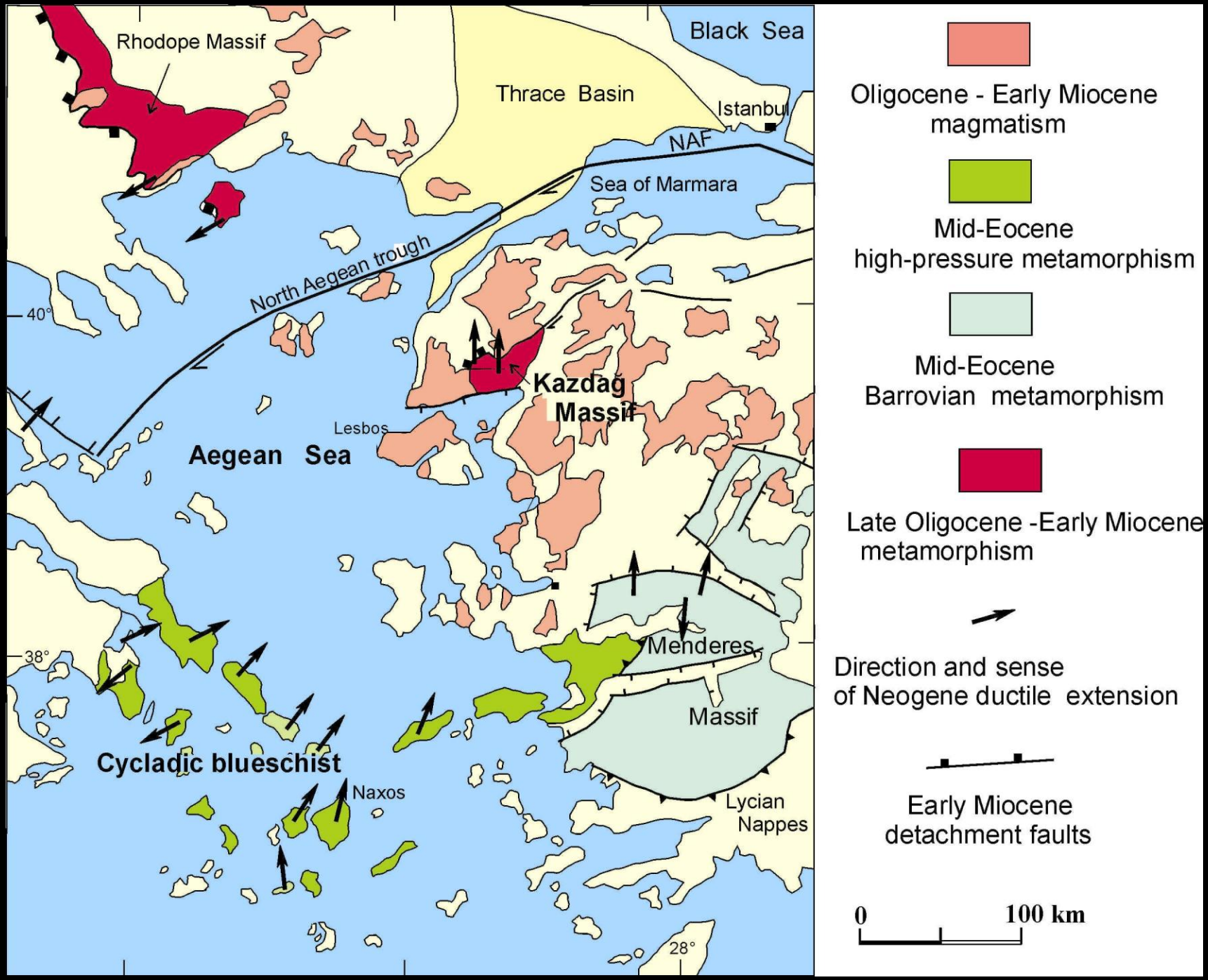
Genişleme tektoniğine bağlı olarak Kazdag metamorfik kompleksi kabuk içinde ~14 km'den (metamorfizma derinliği) ~ 7 km'ye (granodiyorit yerleşme derinliği) yükseliyor.

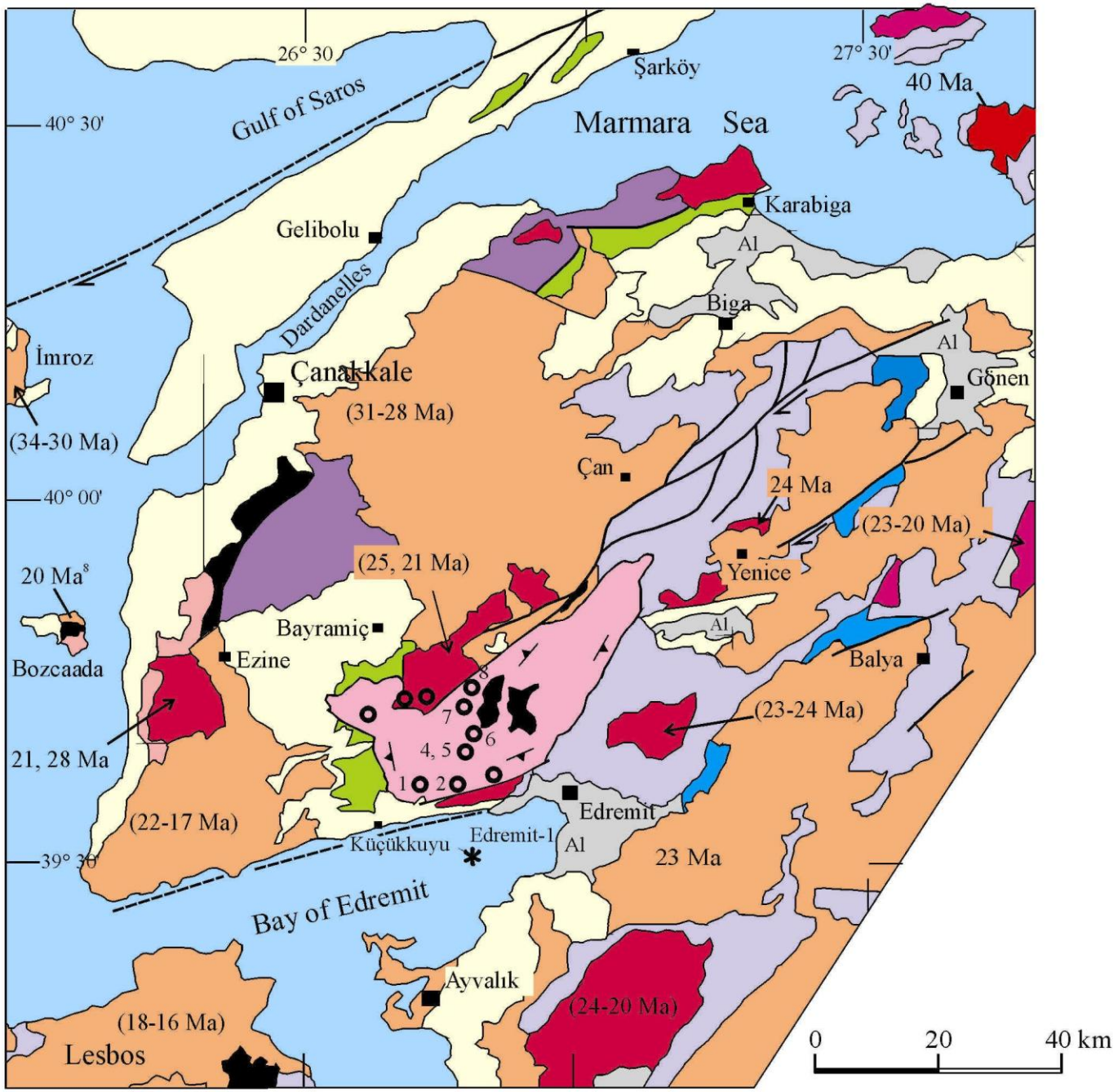
Genişleme Geç Oligosen-Erken Miyosen yaşta bir magmatik yayın merkezinde meydana geliyor.

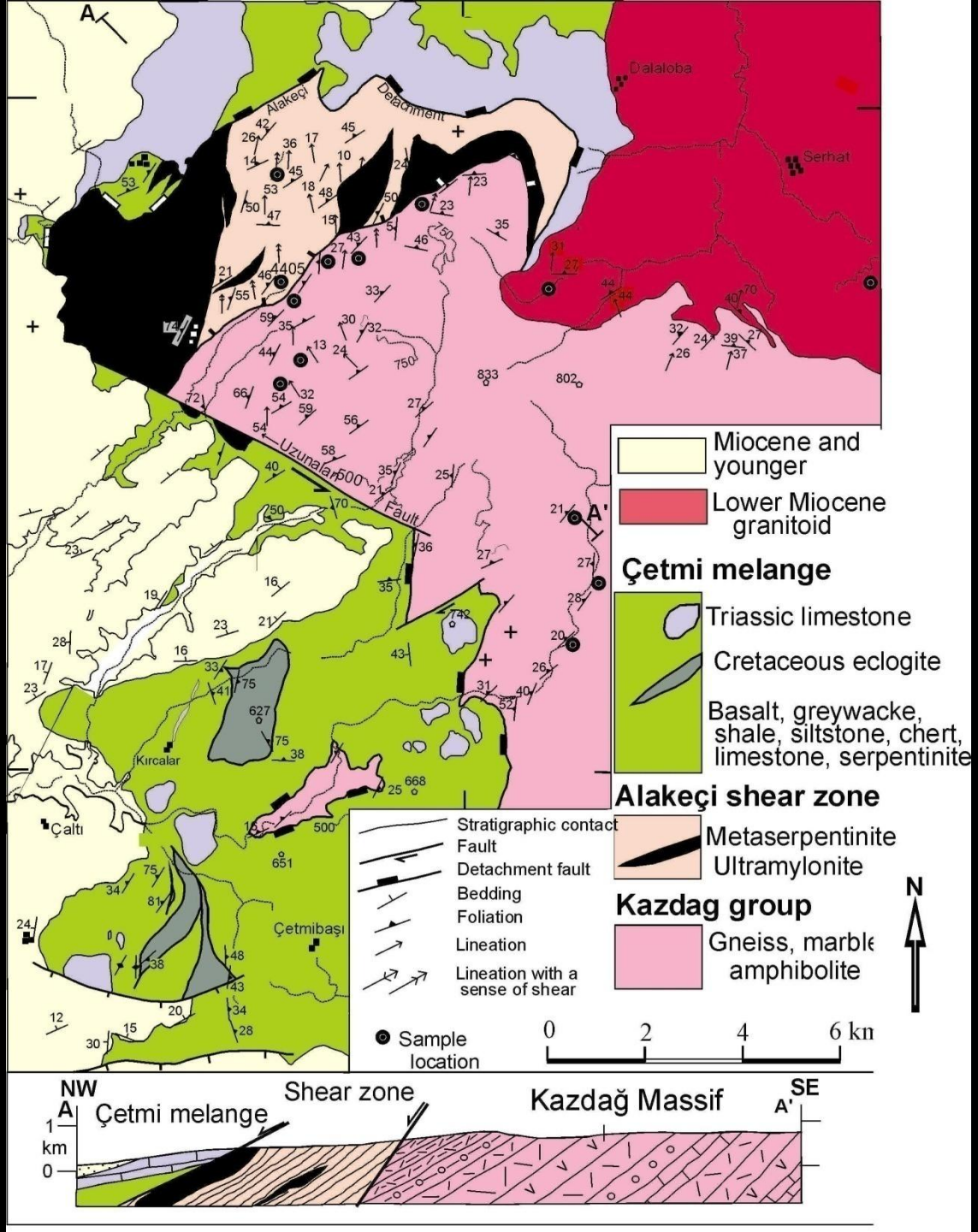
Genişlemenin nedeni Hellen dalma batma zonunun güneye doğru göçü.

Kuzeybatı Anadolu'da var olan denizel Eosen sedimanlar ve Oligosen yaşta bölgesel sıkışmaya ait verilerin bulunmaması, genişleme için yerçekimi kaymasının önemli bir neden oluşturmadığını gösteriyor.


22°
26°E
41°N
Black Sea
İstanbul
Marmara Sea
Uludağ
Eskişehir Fault Zone
Sivrihisar
North Anatolian Fault
Kazdag
İzmir-Ankara suture
39°
37°
Aegean Sea
Hellenic subduction zone
22°
26°
Oligo-Miocene extension direction of the mid-crust


Rhodope Massif
Black Sea
Thrace Basin
Istanbul
NAF
Sea of Marmara
North Aegean trough
40°
Kazdağ
Massif
Lesbos
Aegean Sea
38°
Menderes
Massif
Cycladic blueschist
Naxos
Lycian
Nappes
28°
Oligocene - Early Miocene
magmatism
Mid-Eocene
high-pressure metamorphism
Mid-Eocene
Barrovian metamorphism
Late Oligocene -Early Miocene
metamorphism
Direction and sense
of Neogene ductile extension
Early Miocene
detachment faults
0
100 km


26° 30
27° 30'
40° 30'
39° 30'
Gulf of Saros
Şarköy
40 Ma
Marmara Sea
Karabiga
Gelibolu
Al
Dardanelles
Biga
İmroz
Çanakkale
(31-28 Ma)
Al
Gönen
(34-30 Ma)
Çan
40° 00'
24 Ma
(23-20 Ma)
(25, 21 Ma)
Yenice
20 Ma
Bayramiç
Al
Ezine
Balya
Bozcaada
8
7
6
4, 5
1
2
(23-24 Ma)
21, 28 Ma
Edremit
(22-17 Ma)
Küçükkuyu
Edremit-1
Al
23 Ma
Bay of Edremit
Ayvalık
(24-20 Ma)
(18-16 Ma)
Lesbos
0
20
40 km


A
A'
Dalaloba
Serhat
Alakeçi
Detachment
Uzunalan
Fault
Kırcalar
Çaltı
Çetmibaşı
Miocene and younger
Lower Miocene granitoid
Çetmi melange
Triassic limestone
Cretaceous eclogite
Basalt, greywacke, shale, siltstone, chert, limestone, serpentinite
Alakeçi shear zone
Metaserpentinite
Ultramylonite
Kazdag group
Gneiss, marble amphibolite
Stratigraphic contact
Fault
Detachment fault
Bedding
Foliation
Lineation
Lineation with a sense of shear
Sample location
N
0 2 4 6 km
NW
SE
Çetmi melange
Shear zone
Kazdağ Massif
1 km 0