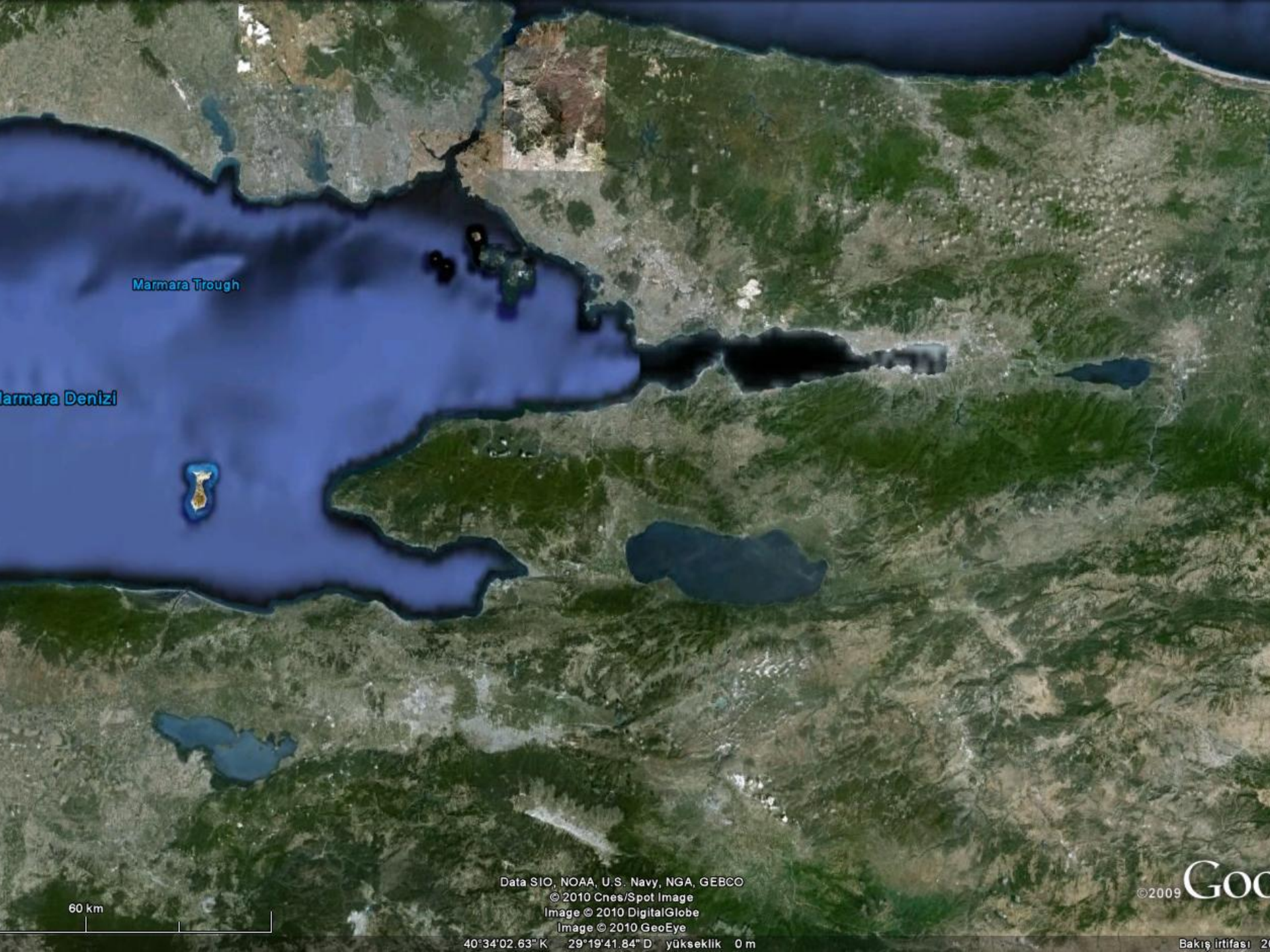
Uludağ'ın jeolojisi: Oligosen yanal atım tektoniği

Aral I. Okay


Marmara Trough
armara Denizi
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2010 Cnes/Spot Image
Image © 2010 DigitalGlobe
Image © 2010 GeoEye
60 km
©2009 Goo
40°34'02.63" K 29°19'41.84" D yükseklik 0 m
Bakış irtifası


N
© 2009 Cnes/Spot Image
Image © 2009 DigitalGlobe
©2007 Google™
inter 40°04'33.00" N 29°13'27.34" E
Streaming 100%
Eye alt 19.20 km


N
Image © 2009 DigitalGlobe
© 2007 Google™
Pointer 40°05'59.14" N 29°09'56.65" E
Streaming 100%
Eye alt 7.93 km


N
© 2009 Cnes/Spot Image
Image © 2009 DigitalGlobe
©2007 Google™
inter 40°04'33.00" N 29°13'27.34" E
Streaming 100%
Eye alt 19.20 km







İhsan Ketin'in Uludağ çalışması

Cilt : I 1947 Sayı : I

TÜRKİYE JEOLOJİ KURUMU BÜLTENİ

İÇİNDEKİLER

Önsöz		
Açılış Nutku	*Hamit Nafiz Pamir*	1
Istranca Masifinin Jeolojik Yapısı		7
(Français)	*H. N. Pamir ve F. Baykal*	26
Karadeniz Ereğlisinde Bulunan Fosilli Üst Silur Tabakalarına Dair Not		44
(English)	*Recep Egemen*	55
Ulu Dağ Masifinin Tektoniği Hakkında		60
(Deutsch)	*İhsan Ketin*	75
Türkiye ile İskoçya Arasında Bir Mukayese		89
(English)	*W. J. McCallien*	91
Türkiye Petrol Bölgeleri İle Doğu Avrupa ve Batı Asya Petrol Bölgeleri Arasında Jeolojik Münasebetler		110
(Français)	*E. Lahn*	120
Uşak Kuzeyinde Bir Kristalen Şist Kütlesi Hakkında		134
(Français)	*M. Tokay ve O. Bayramgil*	142
Mail Tabakalarda Vasatı Sismik Süratlerin Tayini		150
(English)	*Ililmi F. Sagoçi*	154
Kocaeli Triasında Yeni Fosil Yatakları		158
(English)	*Kemal Erguvanlı*	161
Yukarı Gediz Vadisinde Miosene Ait Vertebre Fosiller		164
(Français)	*İsmail Yalçınlar*	171
Milletler Arası Jeoloji Kongresi		178
İdare Heyeti, Üyeler		180

Adres:

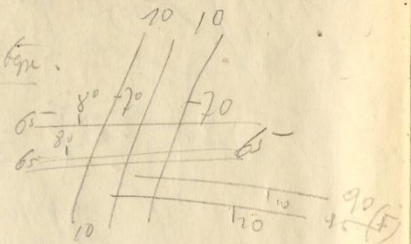
Doçent Ihsan Ketin
Üniversite jeoloji Enstitüsü
Müftülük - Istanbul

I.

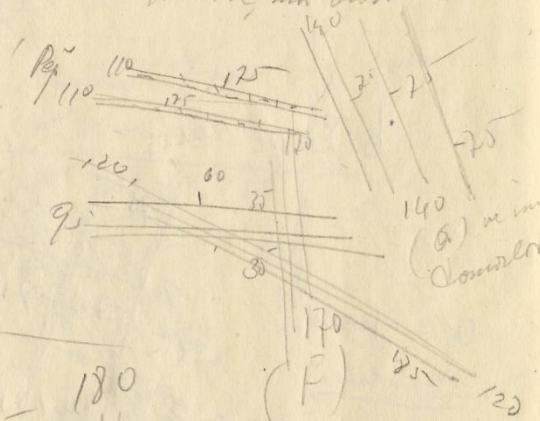
„Uludağ Bölgesi"

27/VII/1928 Cumartesi

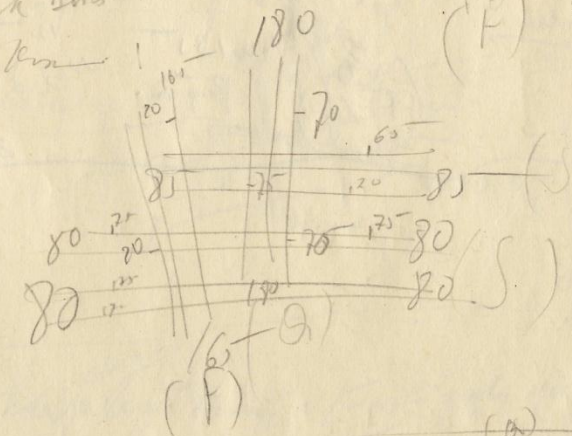
25) Ötel arkası - hafif yassı bir.



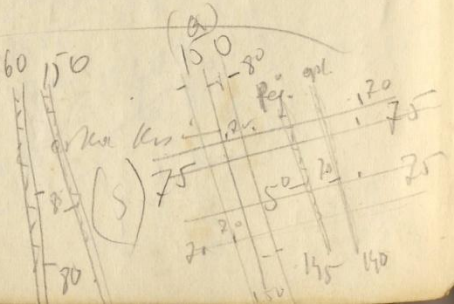
26) Ötel NE sırtı - iki kattiçinin yassı.



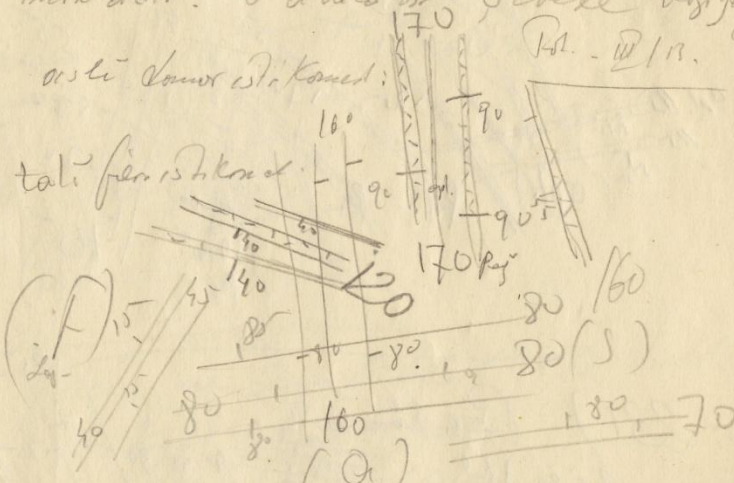
27) Su yolcu şimalinde yuvarlak sırtın yeri kısmen!



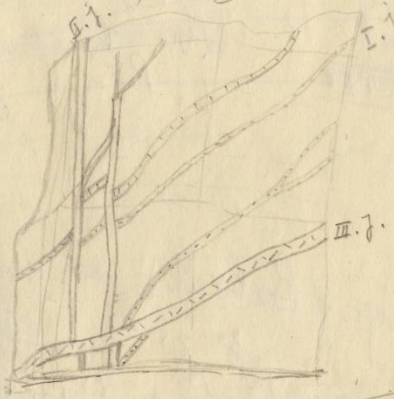
28) Bakacak Cumnu arkası kısmen



229) Fıçılarda çok fazla kayası.
Bakacak sırtı.
Kontakta yaklaştıkça fıçılar çoğalmaktadır. Adeta bir şebeke vaziyetindedir. Yük. - III/13.

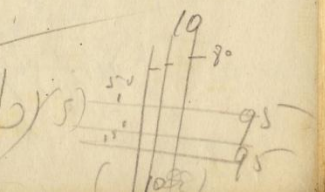


Dağılan dağınık kayalar üç jenerasyon da seyrekleşmiş: Yük: III/13.



Her jenerasyon, dağınık kayalar çoğunca küçük bir kayma düzlemi üzerinde bir evvelki dağınık bir sonraki çatlak boyunca kaymış görünüşlerdedir! (şekle bak!)

Her üç safhada fırlamalar: Peşmolds ve önü kısmi

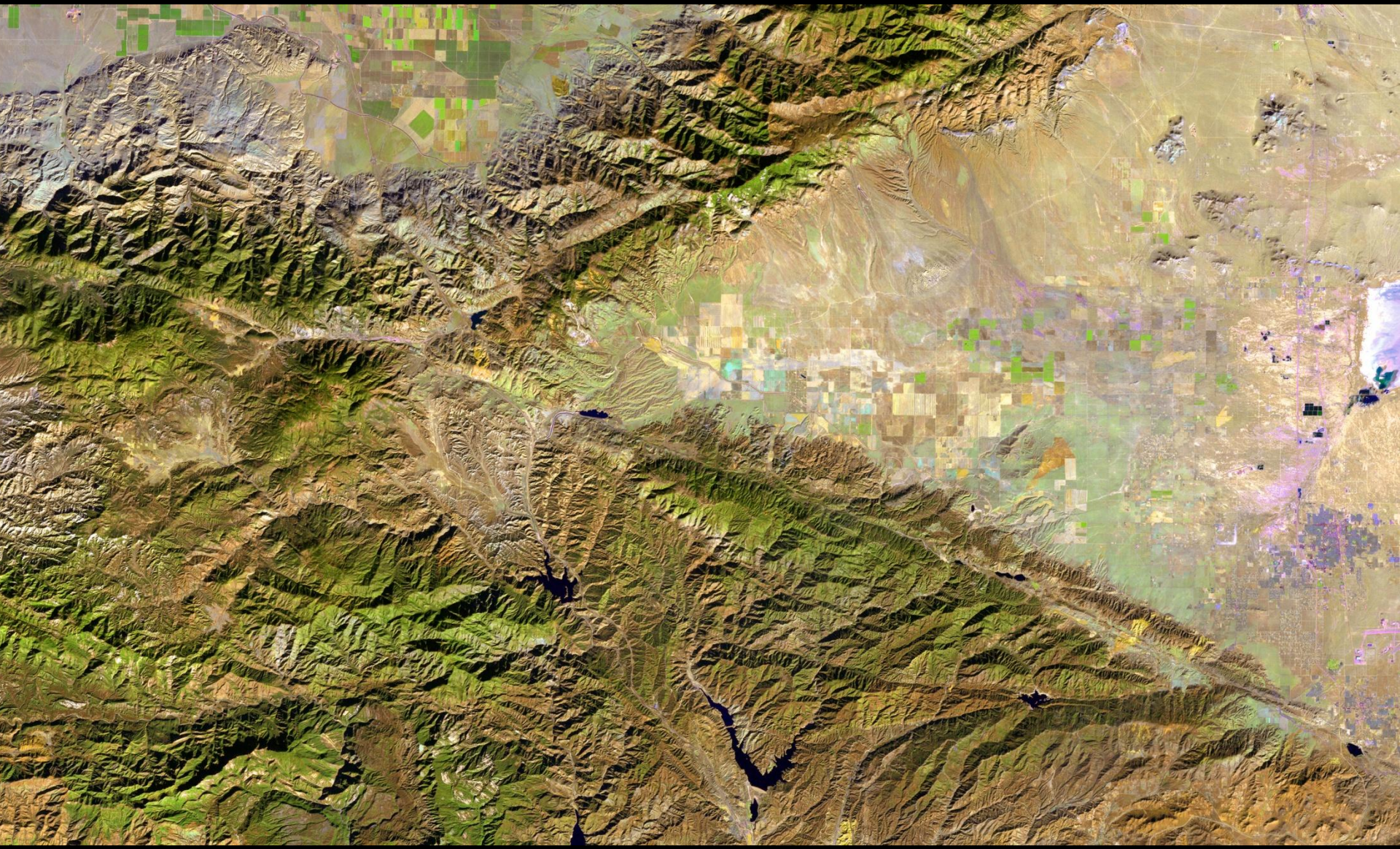


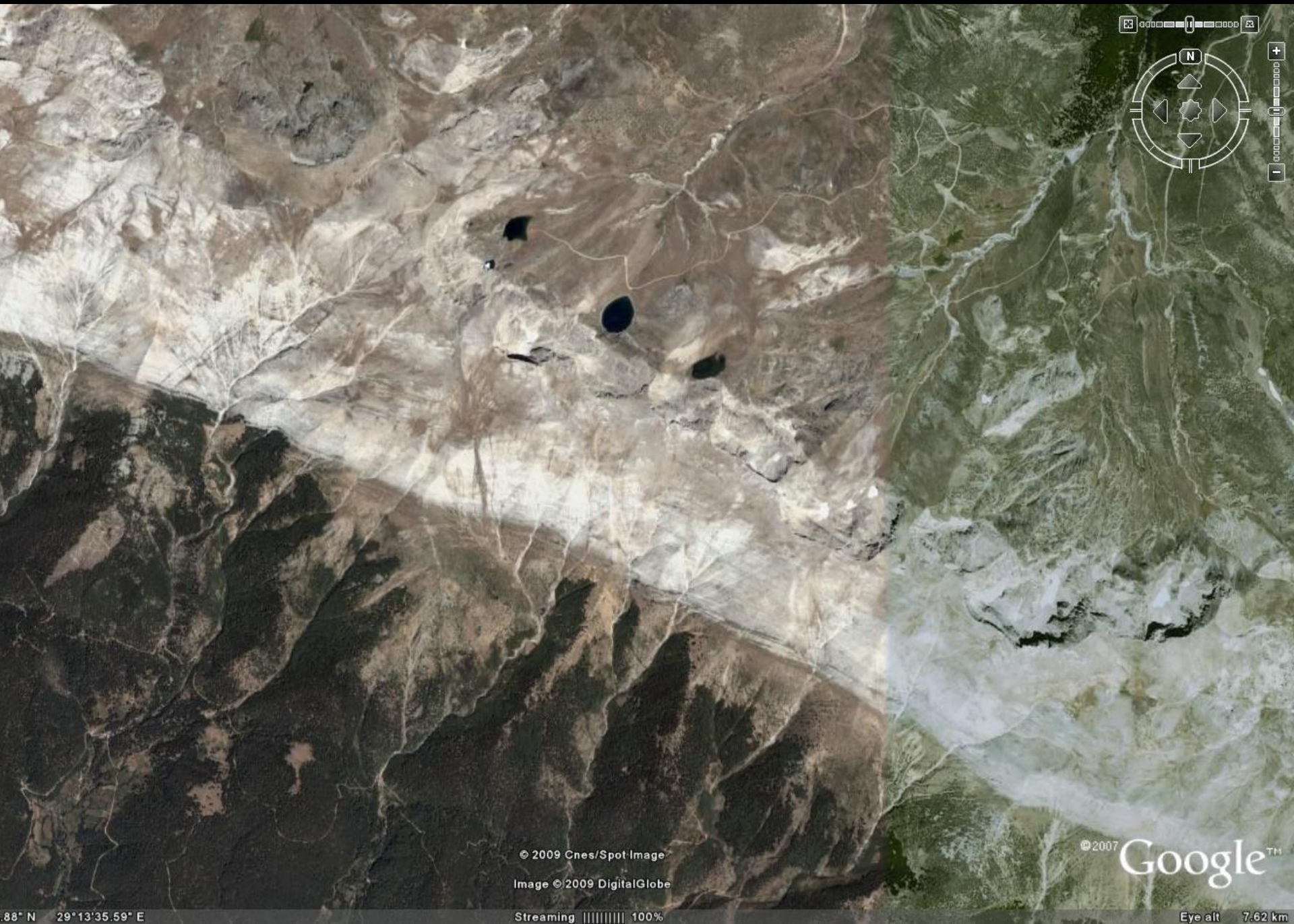
ULUDAĞ-MASİFİNİN JEOLOJİK HARTA VE PROFİLLERİ

İhsan Kelin
1946




N
Image © 2008 DigitalGlobe
Image © 2008 TerraMetrics
©2007 Google™
Pointer 40°04'11.74" N 29°12'45.27" E elev 2323 m
Streaming 100%
Eye alt 22.98 km

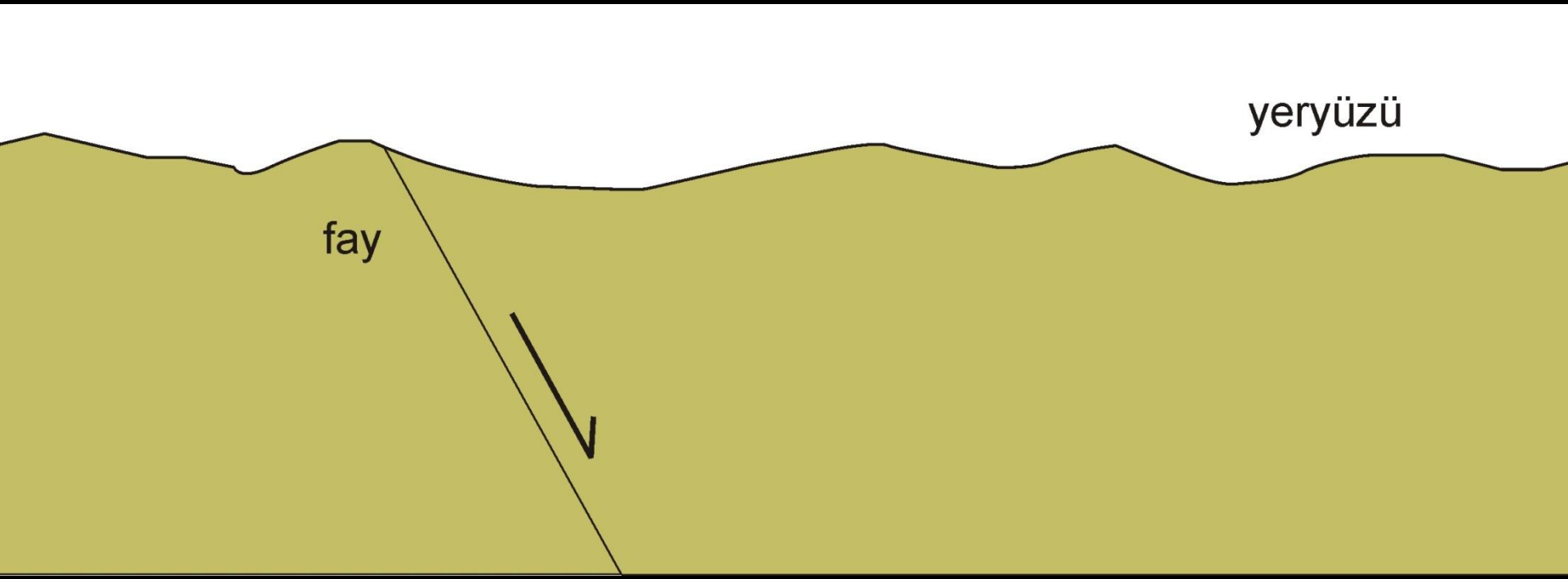


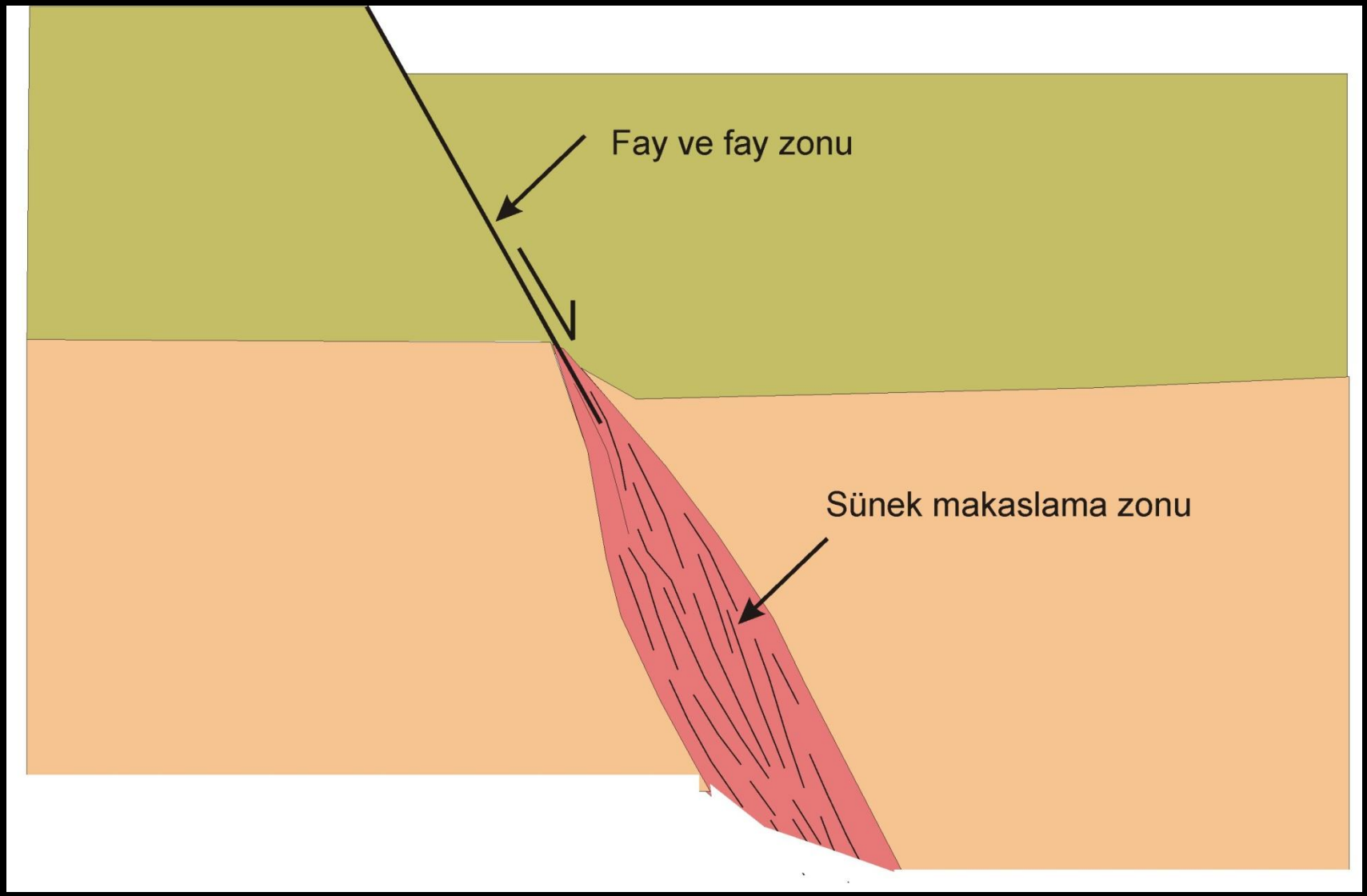

N
© 2009 Cnes/Spot Image
Image © 2009 DigitalGlobe
©2007 Google™
.88" N 29°13'35.59" E
Streaming 100%
Eye alt 7.62 km

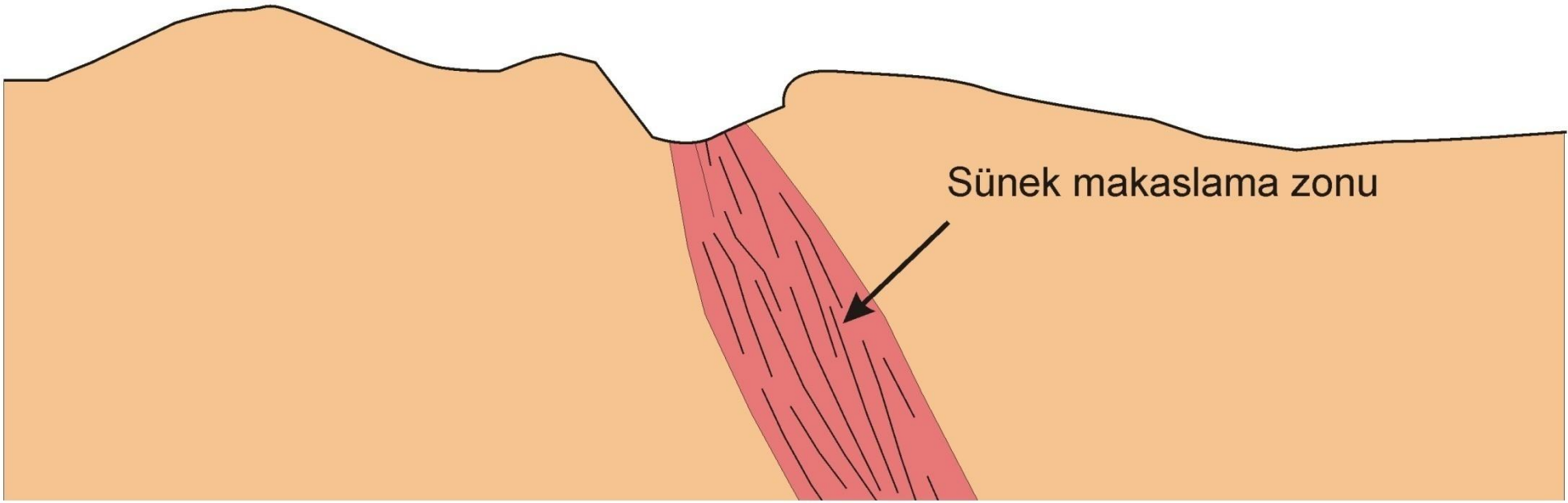
Uludağ

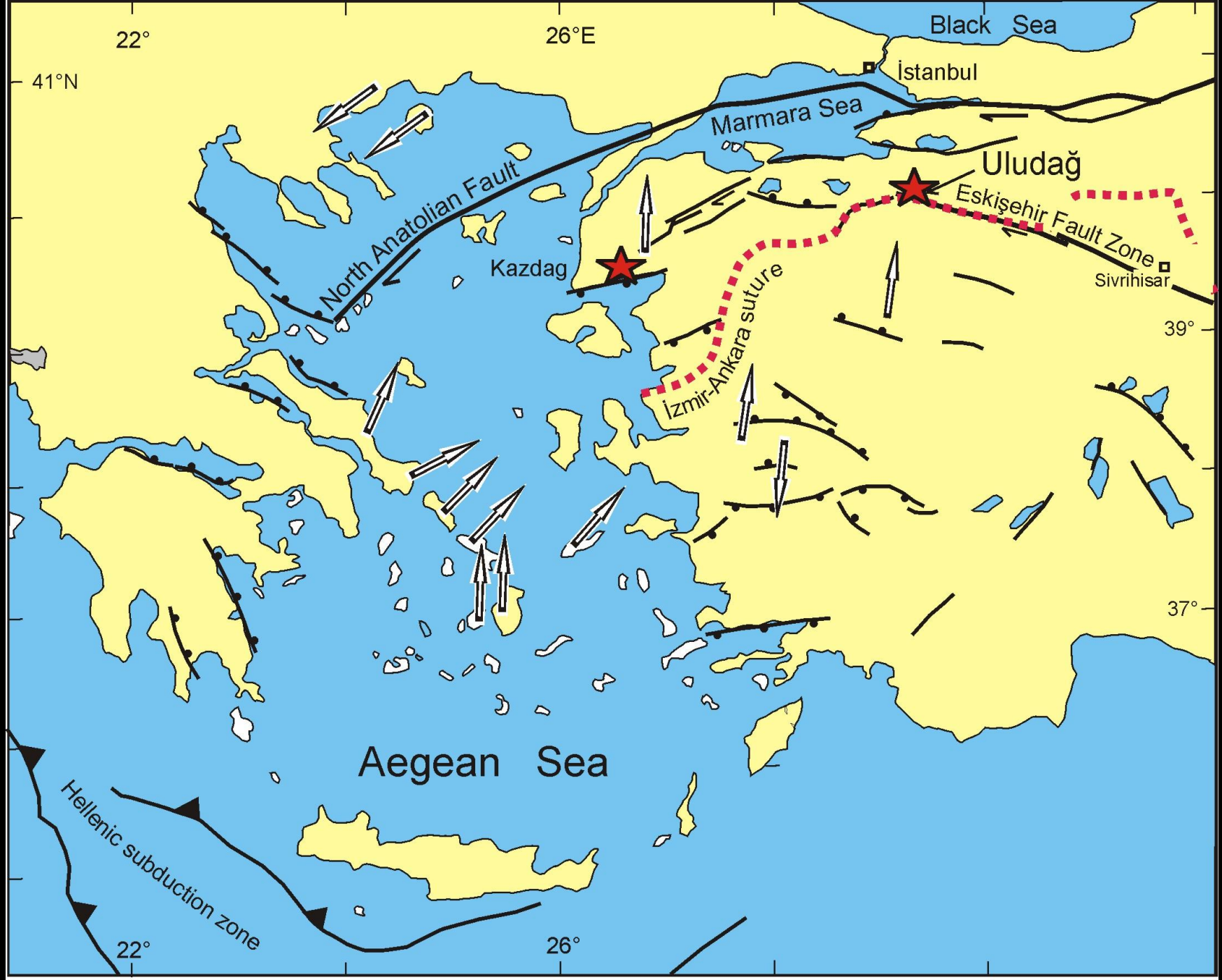
38-27 Ma yaşında
(geç Eosen-Oligosen)

doğrultu-atımlı sünek bir makaslama zonu

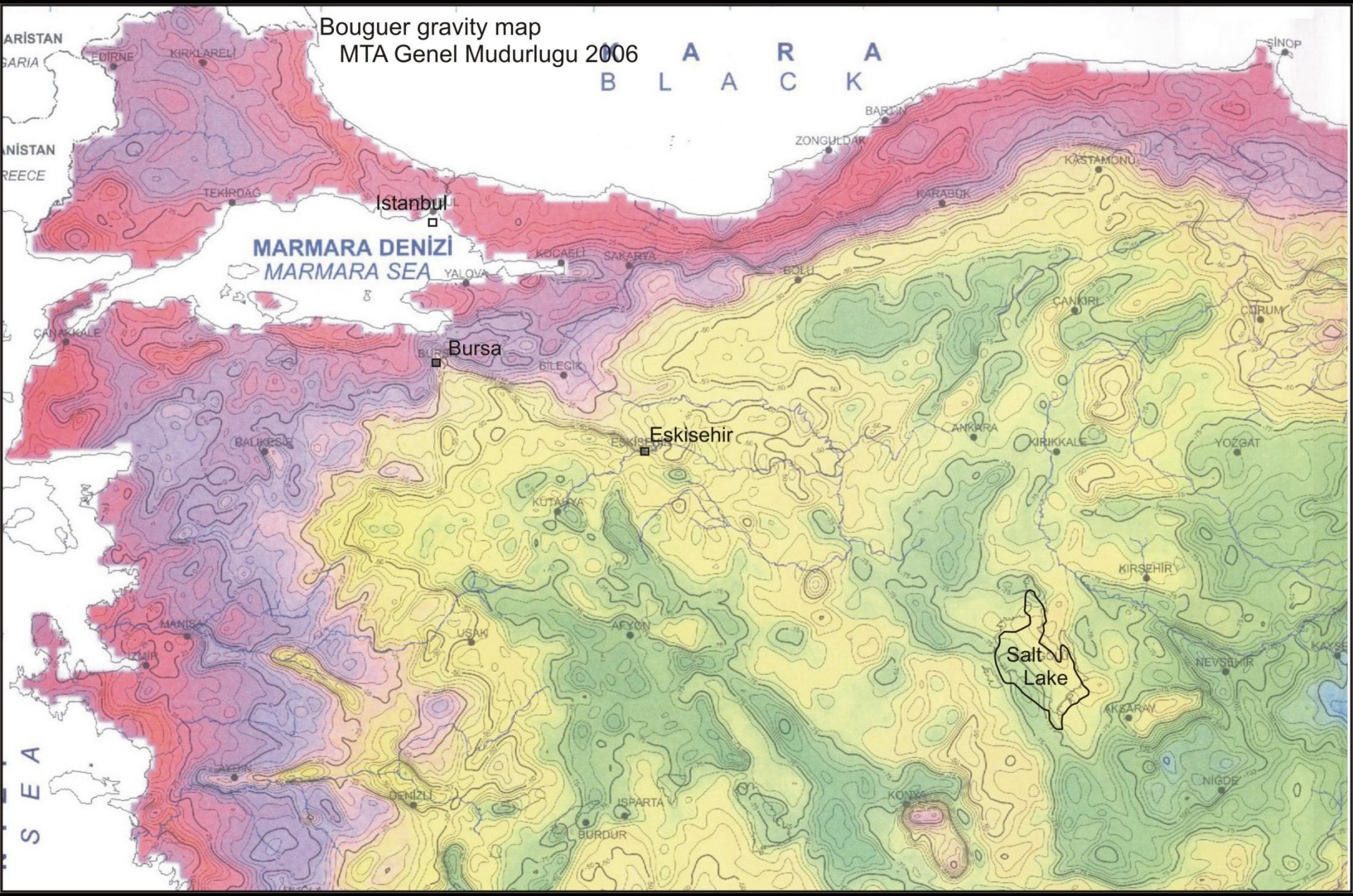

yeryüzü
fay

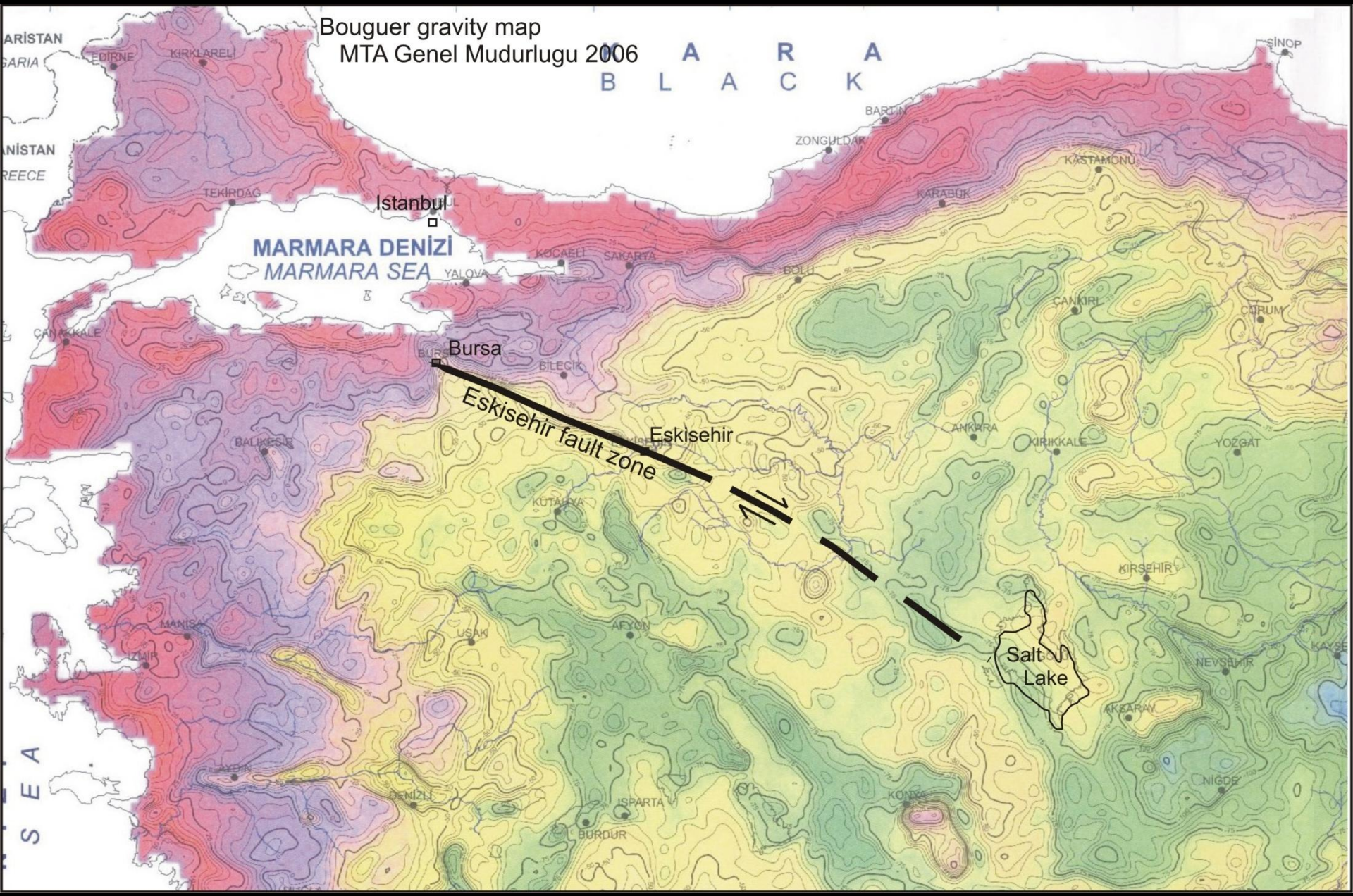

Fay ve fay zonu
Sünek makaslama zonu


Sünek makaslama zonu

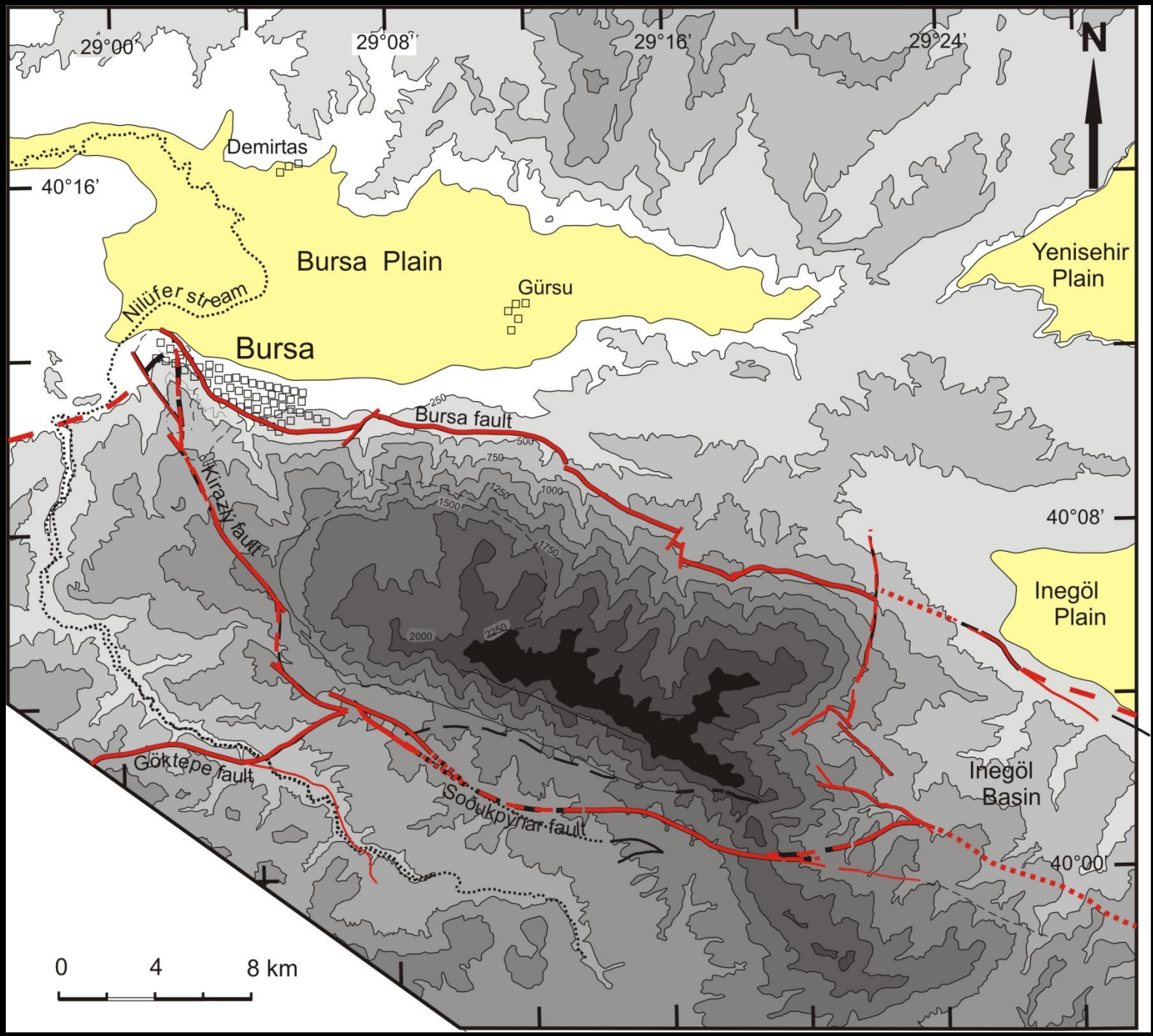


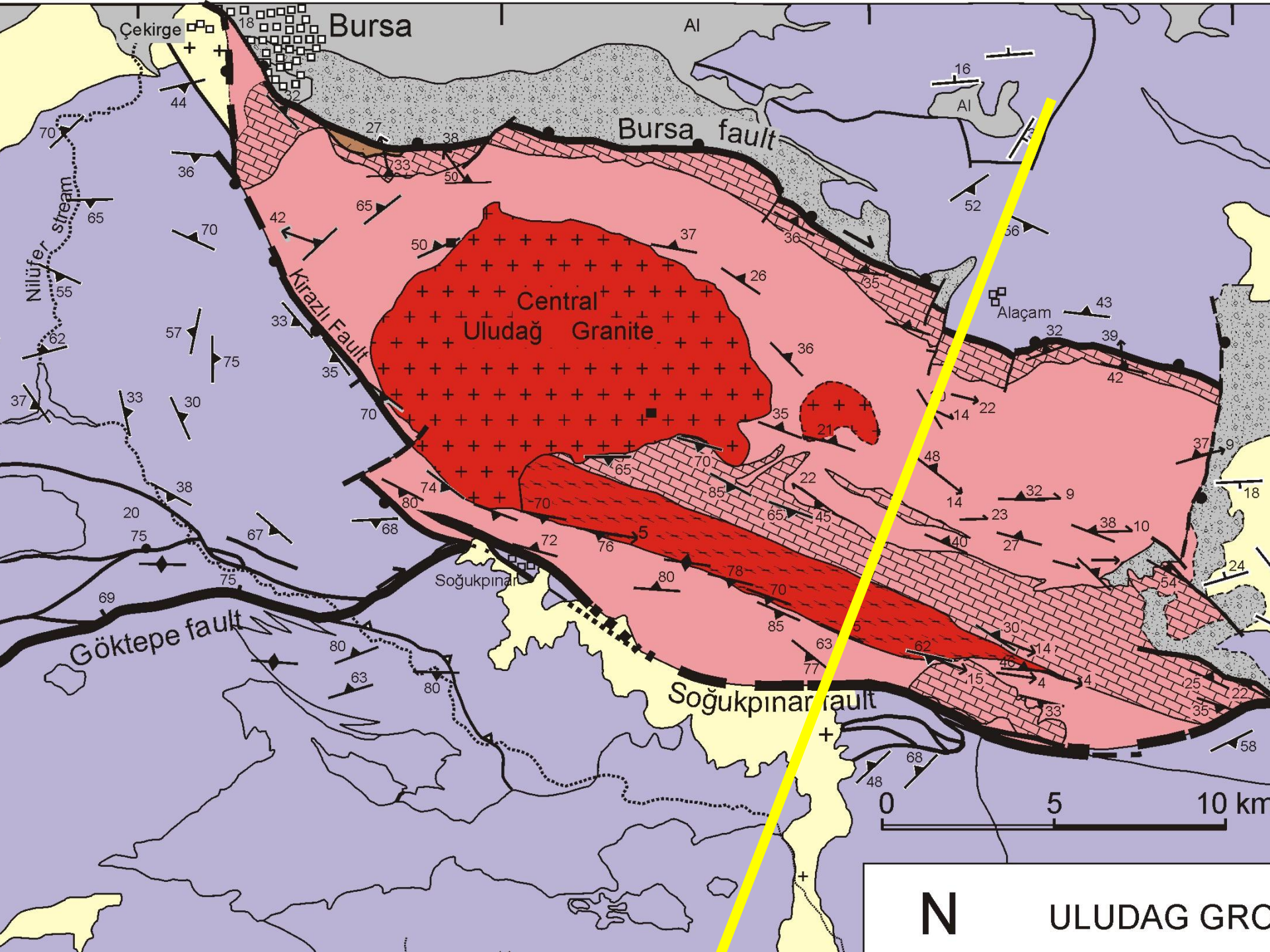
Oligo-Miocene extension direction of the mid-crust

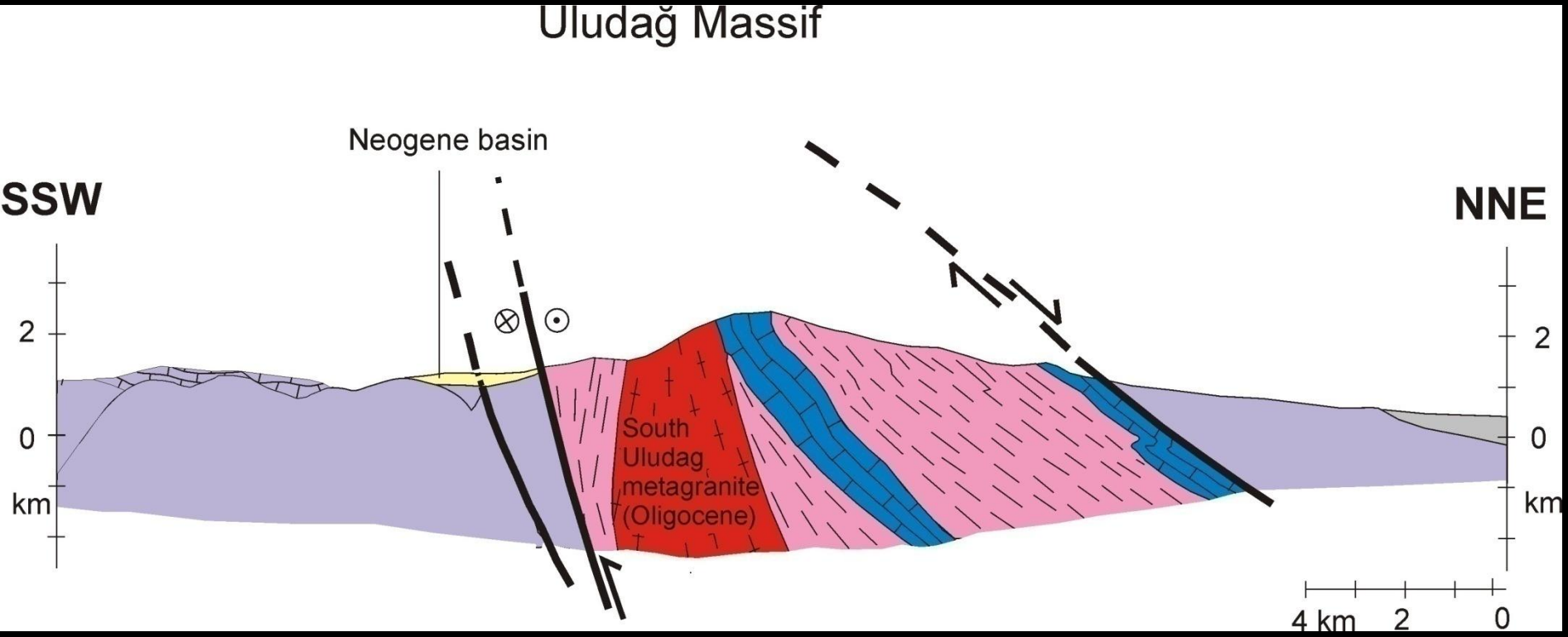

Bouguer gravity map
MTA Genel Mudurlugu 2006
B L A C K
Istanbul
MARMARA DENİZİ
MARMARA SEA
Bursa
Eskisehir
Salt
Lake
EDİRNE
KIRKLARELİ
TEKİRDAĞ
ÇANAKKALE
BALIKESİR
MANİSA
İZMİR
AYDIN
DENİZLİ
BURDUR
ISPARTA
KONYA
AFYON
UŞAK
KÜTAHYA
BİLECİK
YALOVA
KOCAELİ
SAKARYA
BOLU
ZONGULDAK
BARTIN
KARABÜK
KASTAMONU
SİNOP
ÇANKIRI
ÇORUM
ANKARA
KIRIKKALE
YOZGAT
KIRŞEHİR
NEVŞEHİR
AKSARAY
NİĞDE


Bouguer gravity map
MTA Genel Mudurlugu 2006
B L A C K
MARMARA DENİZİ
MARMARA SEA
Istanbul
Bursa
Eskisehir fault zone
Eskisehir
Salt Lake
EDİRNE
KIRKLARELİ
TEKİRDAĞ
ÇANAKKALE
BALIKESİR
MANİSA
İZMİR
AYDIN
DENİZLİ
UŞAK
AFYON
KÜTAHYA
BİLECİK
YALOVA
KOCAELİ
SAKARYA
BOLU
ZONGULDAK
BARTIN
KASTAMONU
KARABÜK
ÇANKIRI
ÇORUM
SİNOP
ANKARA
KIRIKKALE
YOZGAT
KIRŞEHİR
NEVŞEHİR
AKSARAY
NİĞDE
KONYA
ISPARTA
BURDUR


N
Image © 2008 DigitalGlobe
Image © 2008 TerraMetrics
©2007 Google™
Pointer 40°04'11.74" N 29°12'45.27" E elev 2323 m
Streaming 100%
Eye alt 22.98 km


29°00'
29°08'
29°16'
29°24'
N
Demirtas
40°16'
Bursa Plain
Yenisehir Plain
Nilüfer stream
Gürsu
Bursa
250
Bursa fault
500
750
1000
1250
1500
1750
2000
2250
Kirazlı fault
40°08'
Inegöl Plain
Göktepe fault
Soğukpınar fault
Inegöl Basin
40°00'
0
4
8 km

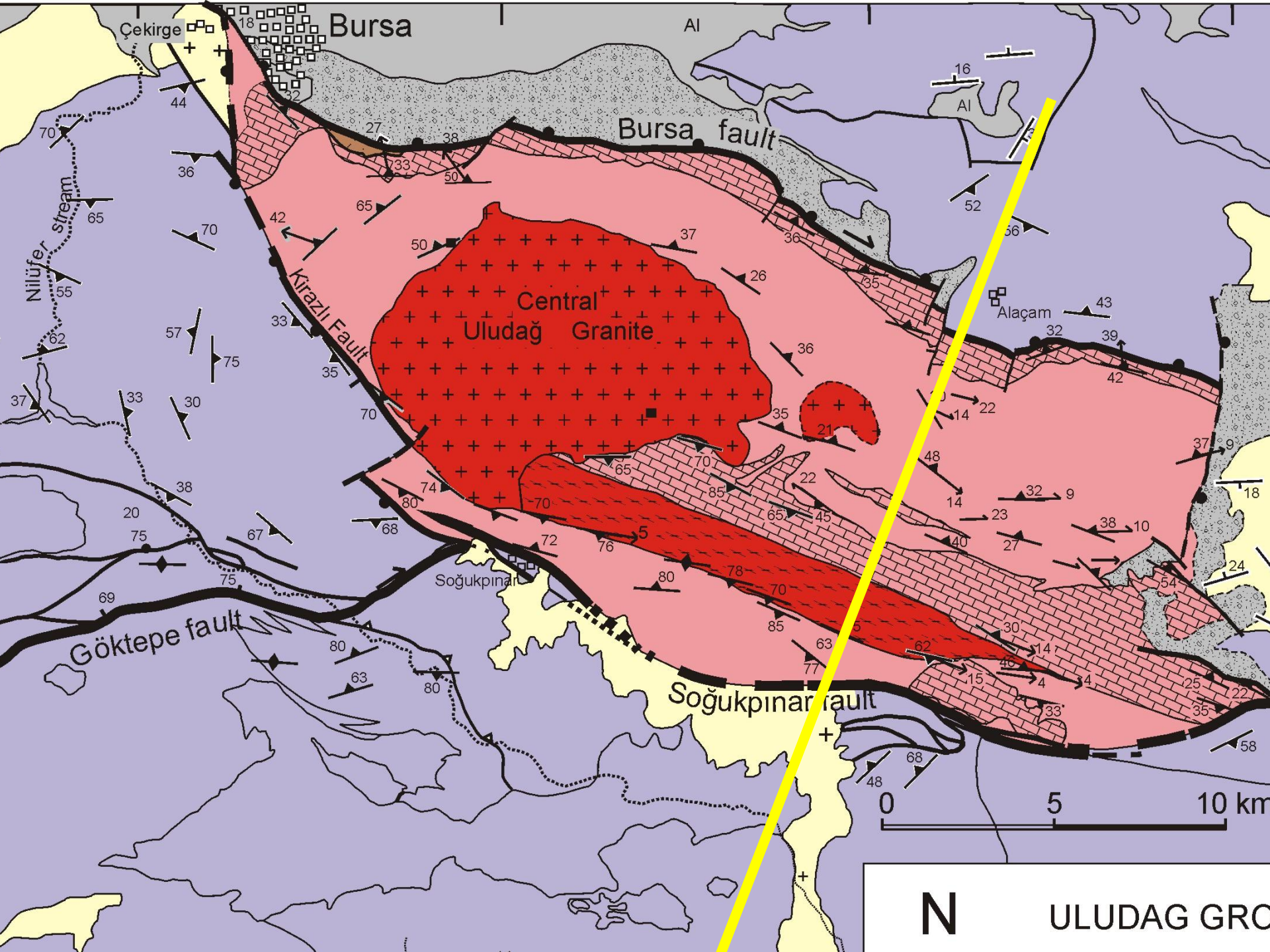

Çekirge
Bursa
Al
Bursa fault
Nilüfer stream
Kirazlı Fault
Central
Uludağ Granite
Alaçam
Soğukpınar
Göktepe fault
Soğukpınar fault
0
5
10 km
N
ULUDAG GRO

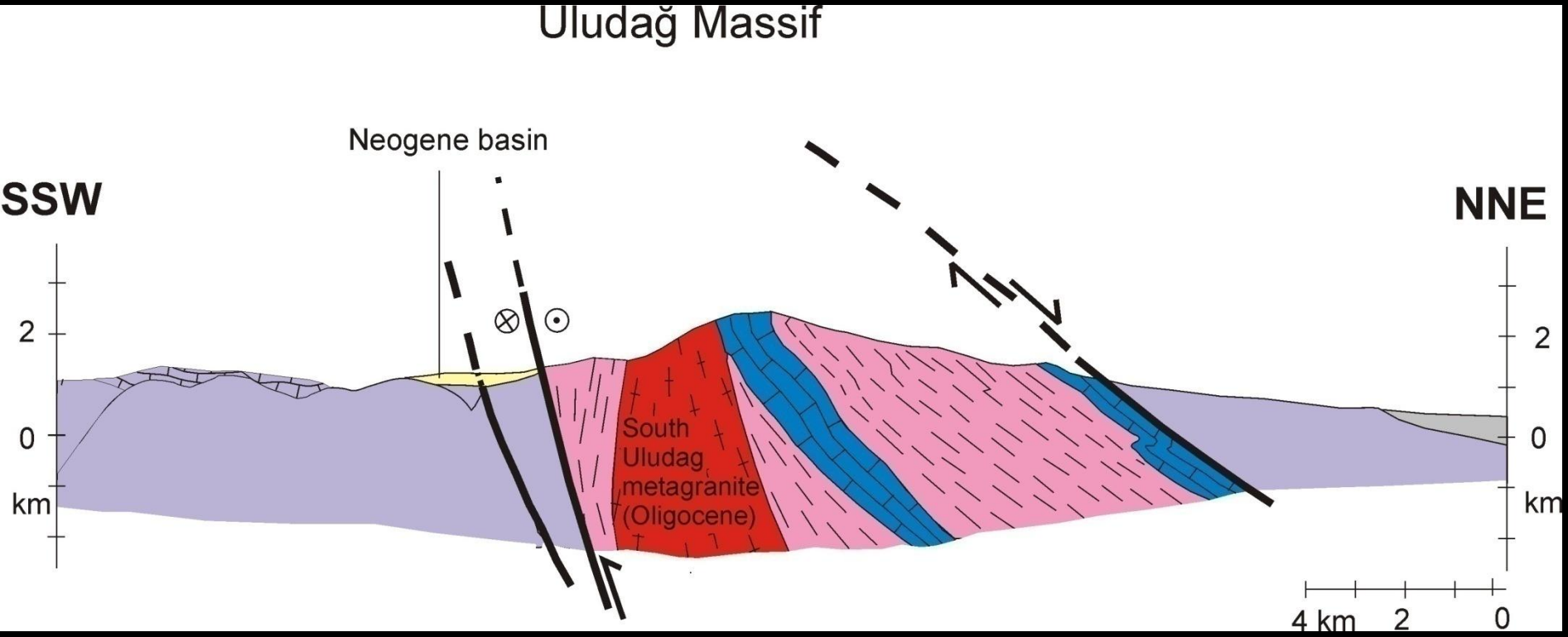

Uludağ Massif
Neogene basin
SSW
NNE
2
0
km
South
Uludag
metagranite
(Oligocene)
4 km
2
0



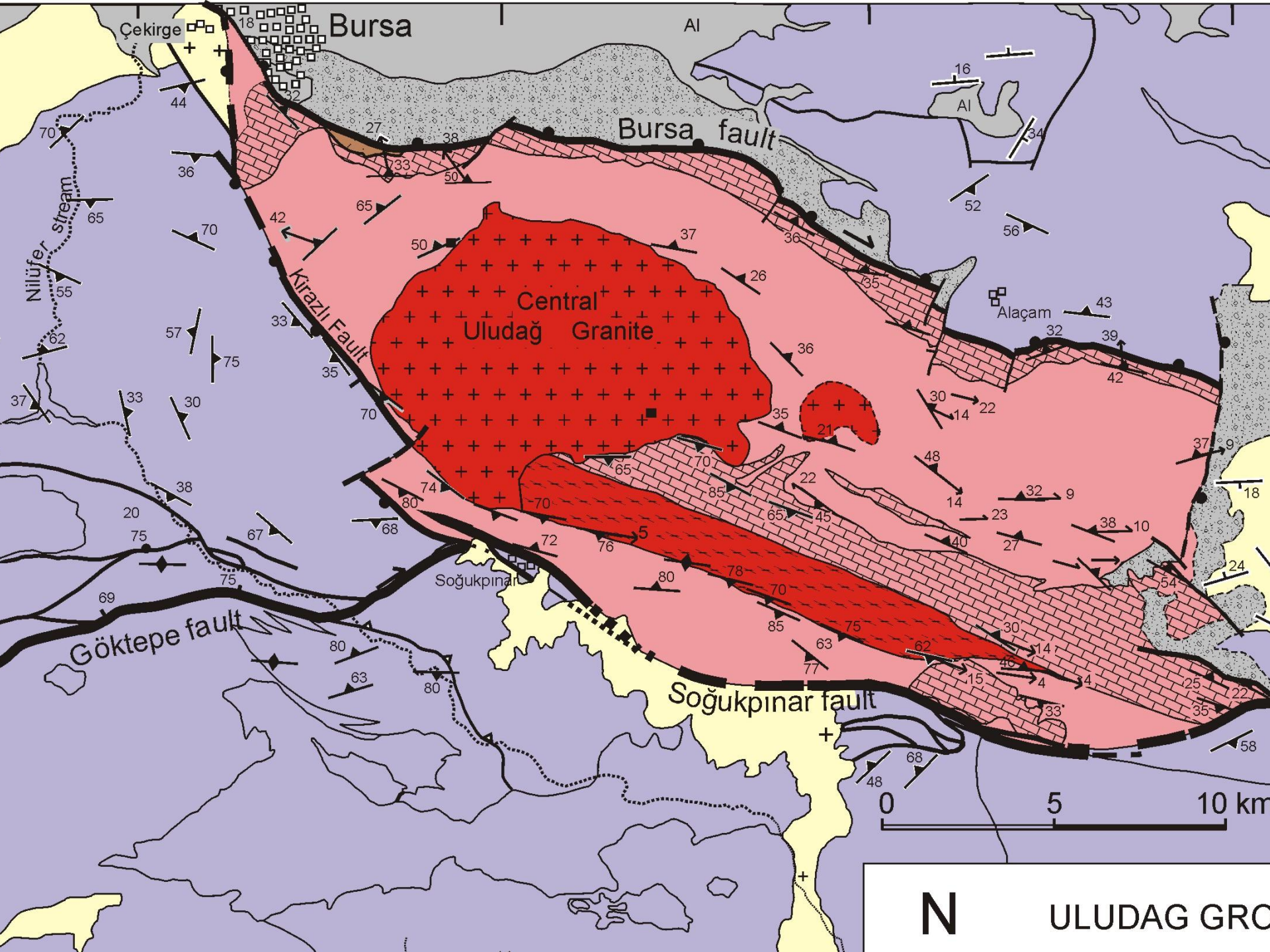





Çekirge
Bursa
Al
Bursa fault
Nilüfer stream
Kirazlı Fault
Central
Uludağ Granite
Alaçam
Soğukpınar
Göktepe fault
Soğukpınar fault
0
5
10 km
N
ULUDAG GRO


Uludağ Massif
Neogene basin
SSW
NNE
2
0
km
South
Uludag
metagranite
(Oligocene)
4 km
2
0




Çekirge
Bursa
Al
Bursa fault
Nilüfer stream
Kirazlı Fault
Central
Uludağ Granite
Alaçam
Soğukpınar
Göktepe fault
Soğukpınar fault
0
5
10 km
N
ULUDAG GRO



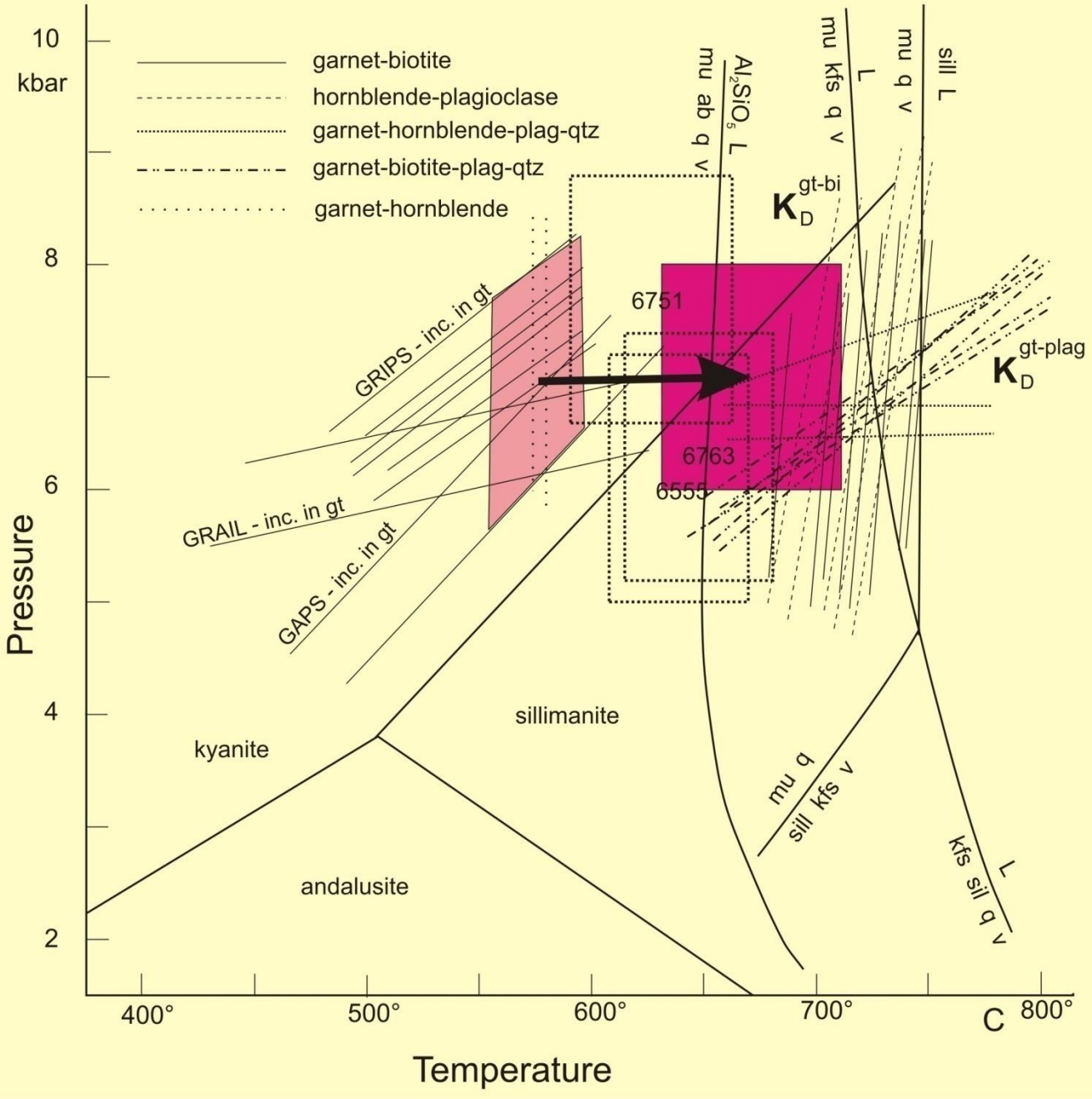









25
YENİ
KURUŞ
2005



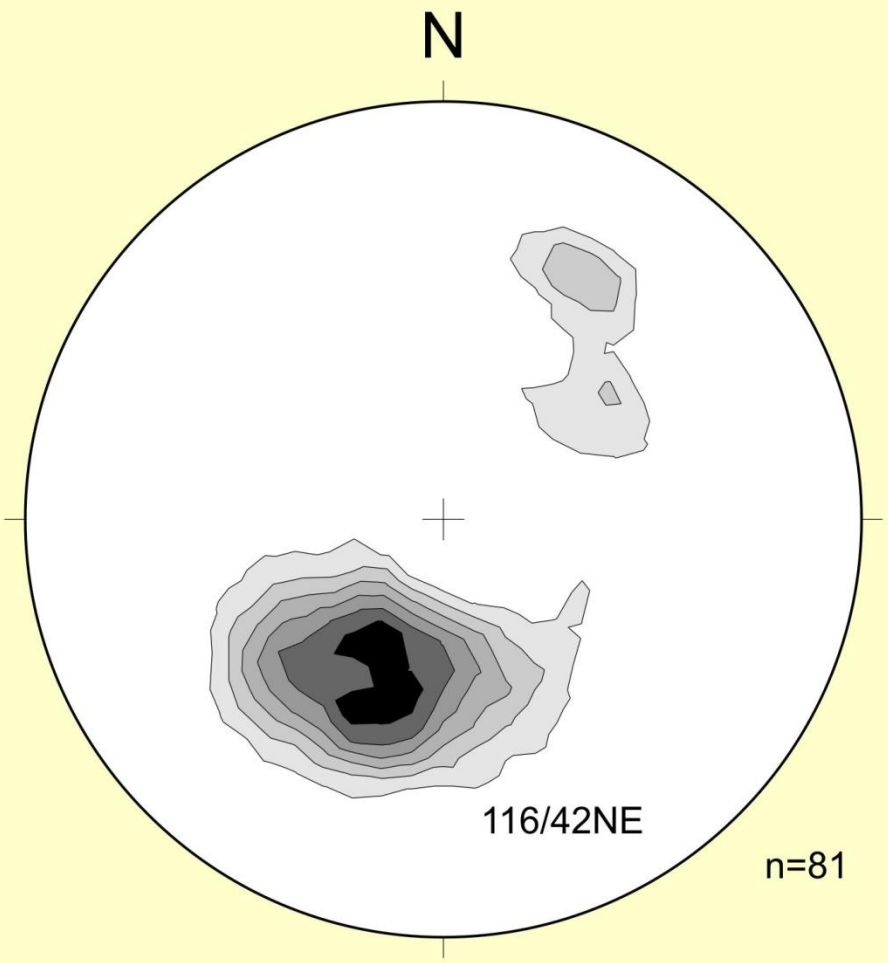
Uludag Group
Pressure-temperature conditions

Yapı

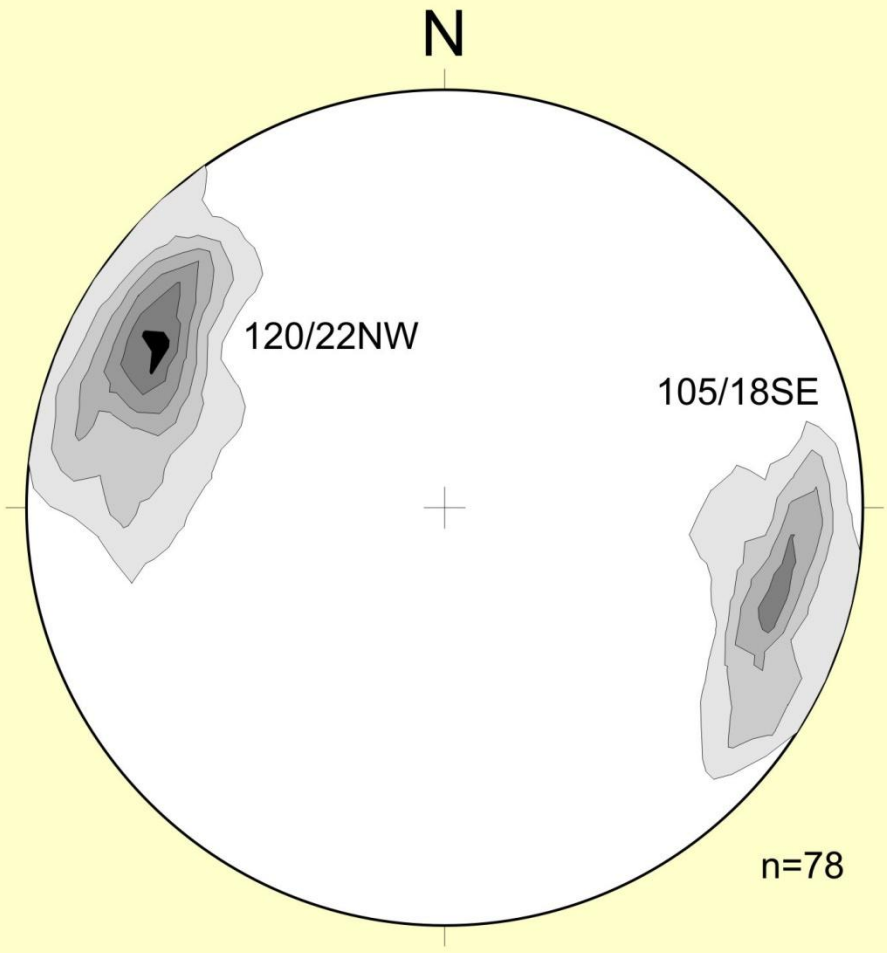
Foliasyon ve lineasyon







Foliation in the Uludağ Massif

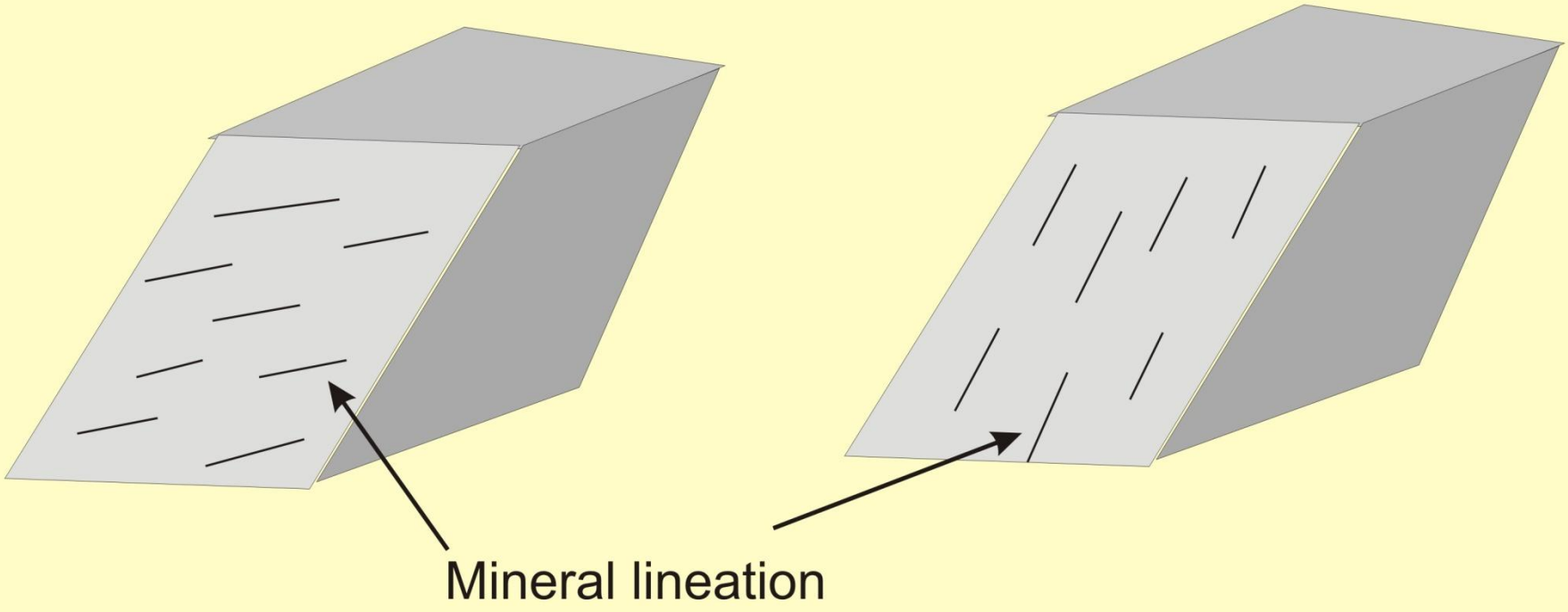


Lineation in the Uludağ Massif

Equal area projection, lower hemisphere projection of structural data from the Uludağ Massif. Contours are at 2, 4, 6, 8, 10, 12 %.

Uludag Massif

Kazdag Massif



Mineral lineation

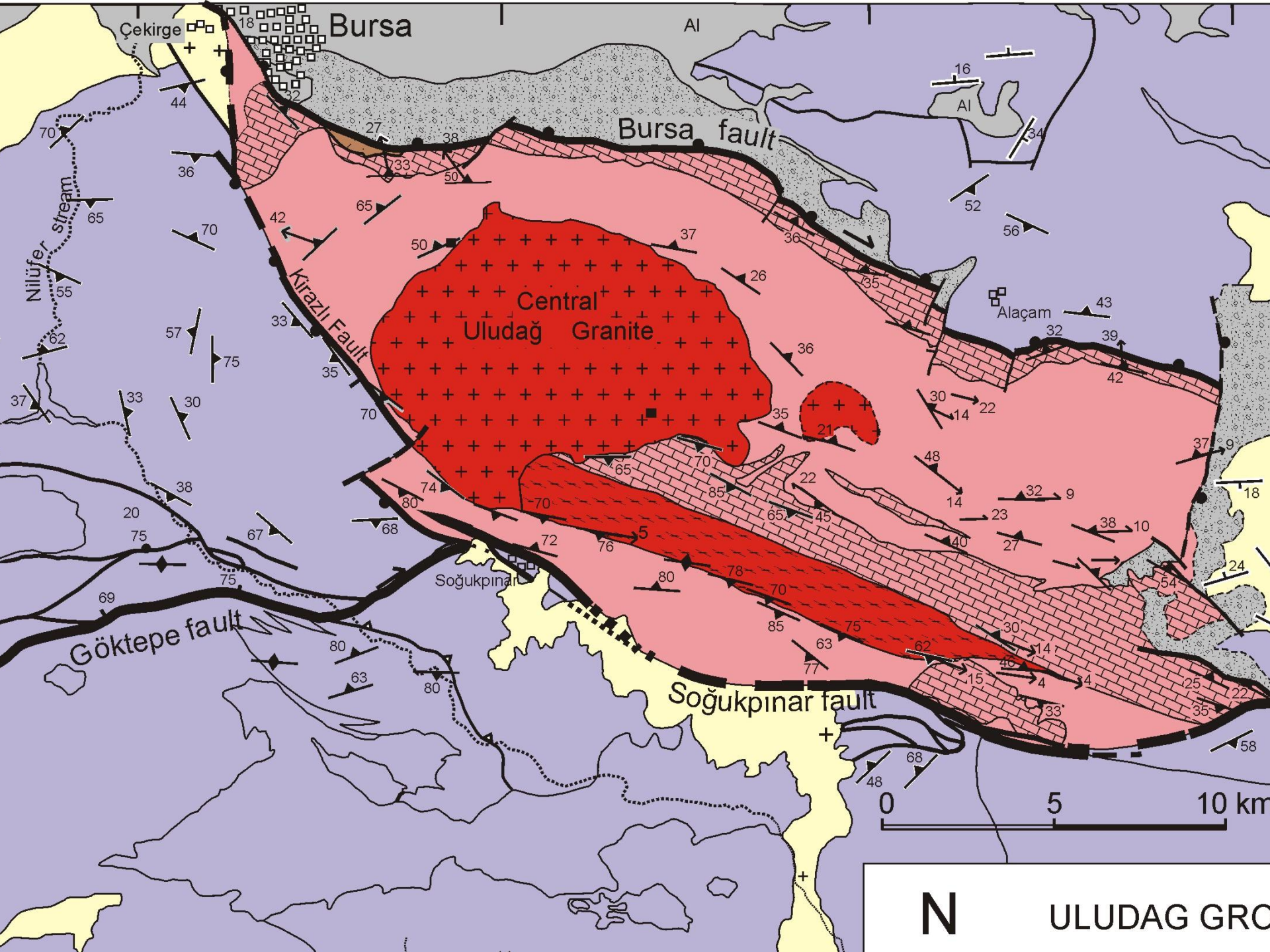
Hareket yönü ?

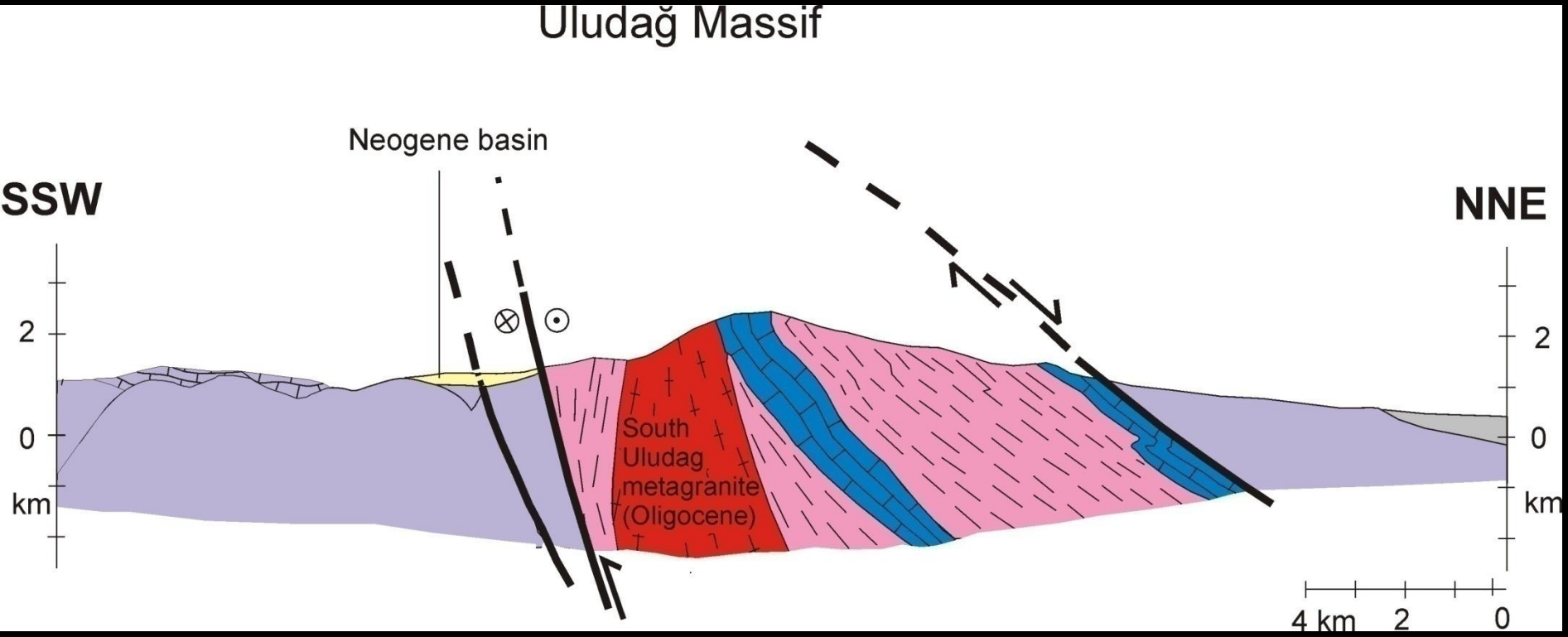




Tektonizma ile eşyaşlı

Güney Uludağ Metagraniti


Çekirge
Bursa
Al
Bursa fault
Nilüfer stream
Kirazlı Fault
Central
Uludağ Granite
Alaçam
Soğukpınar
Göktepe fault
Soğukpınar fault
0
5
10 km
N
ULUDAG GRO


Uludağ Massif
Neogene basin
SSW
NNE
2
0
km
South
Uludag
metagranite
(Oligocene)
4 km
2
0

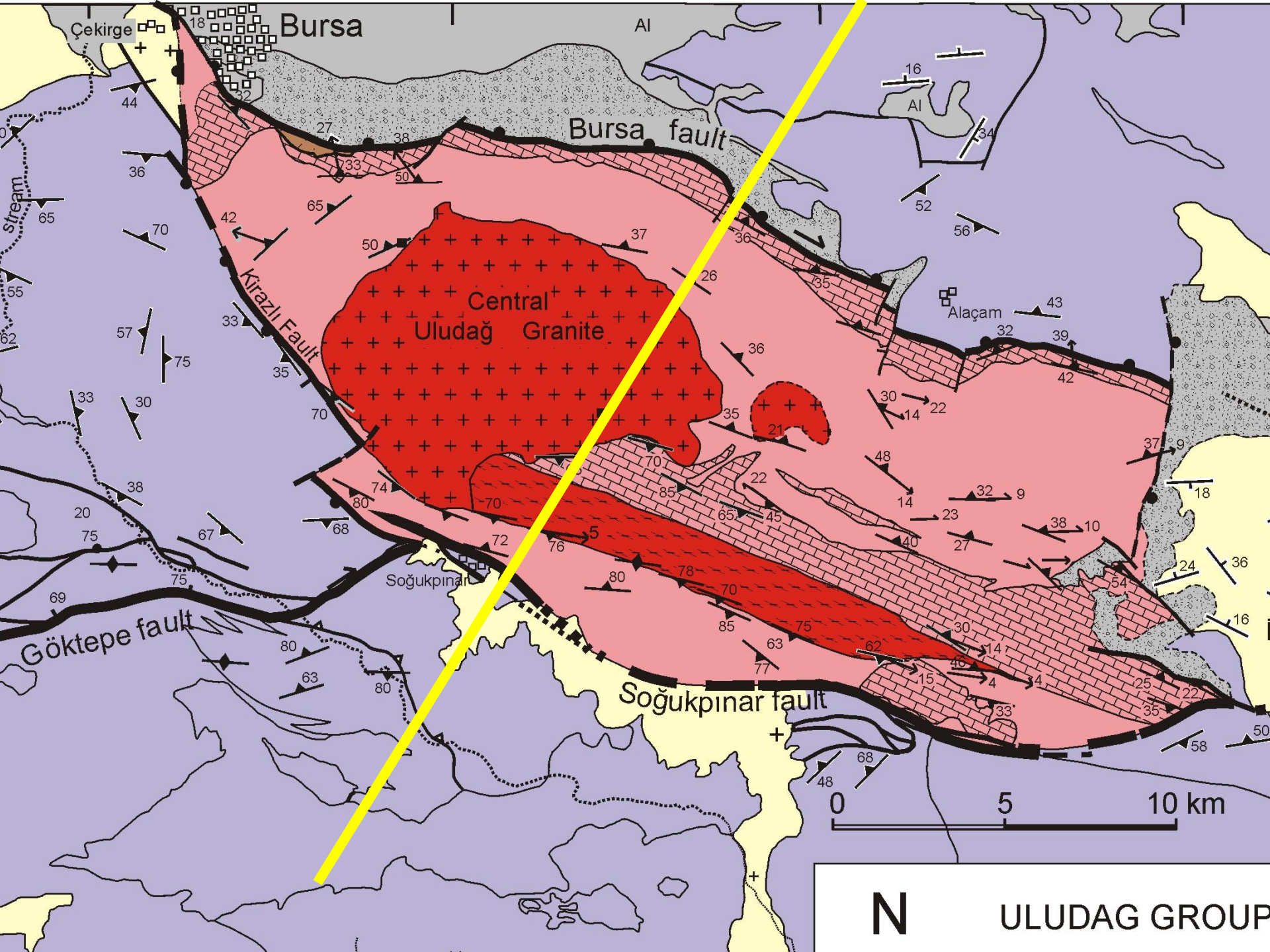

N
Image © 2008 TerraMetrics
Image © 2008 DigitalGlobe
©2007 Google™
pointer 40°04'13.36" N 29°13'40.53" E elev 2395 m
Streaming 100%
Eye alt 22.73 km










Çekirge
Bursa
Al
Bursa fault
Kirazlı Fault
Central
Uludağ Granite
Alaçam
Soğukpınar
Göktepe fault
Soğukpınar fault
stream
0
5
10 km
N
ULUDAG GROUP

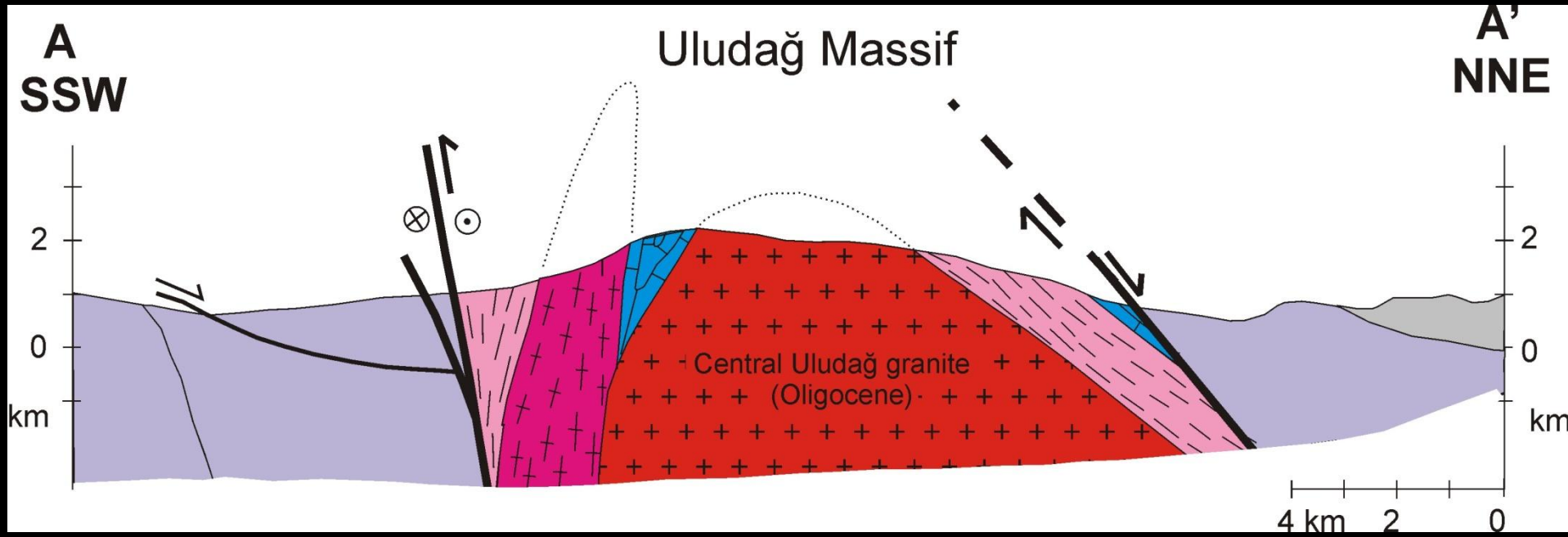

A
SSW
Uludağ Massif
A'
NNE
2
0
km
Central Uludağ granite
(Oligocene)
2
0
km
4 km
2
0


Image © 2008 DigitalGlobe
Image © 2008 TerraMetrics
©2007 Google™
Pointer 40°06'04.70" N 29°09'24.98" E elev 1869 m
Streaming 100%
Eye alt 24.03 km

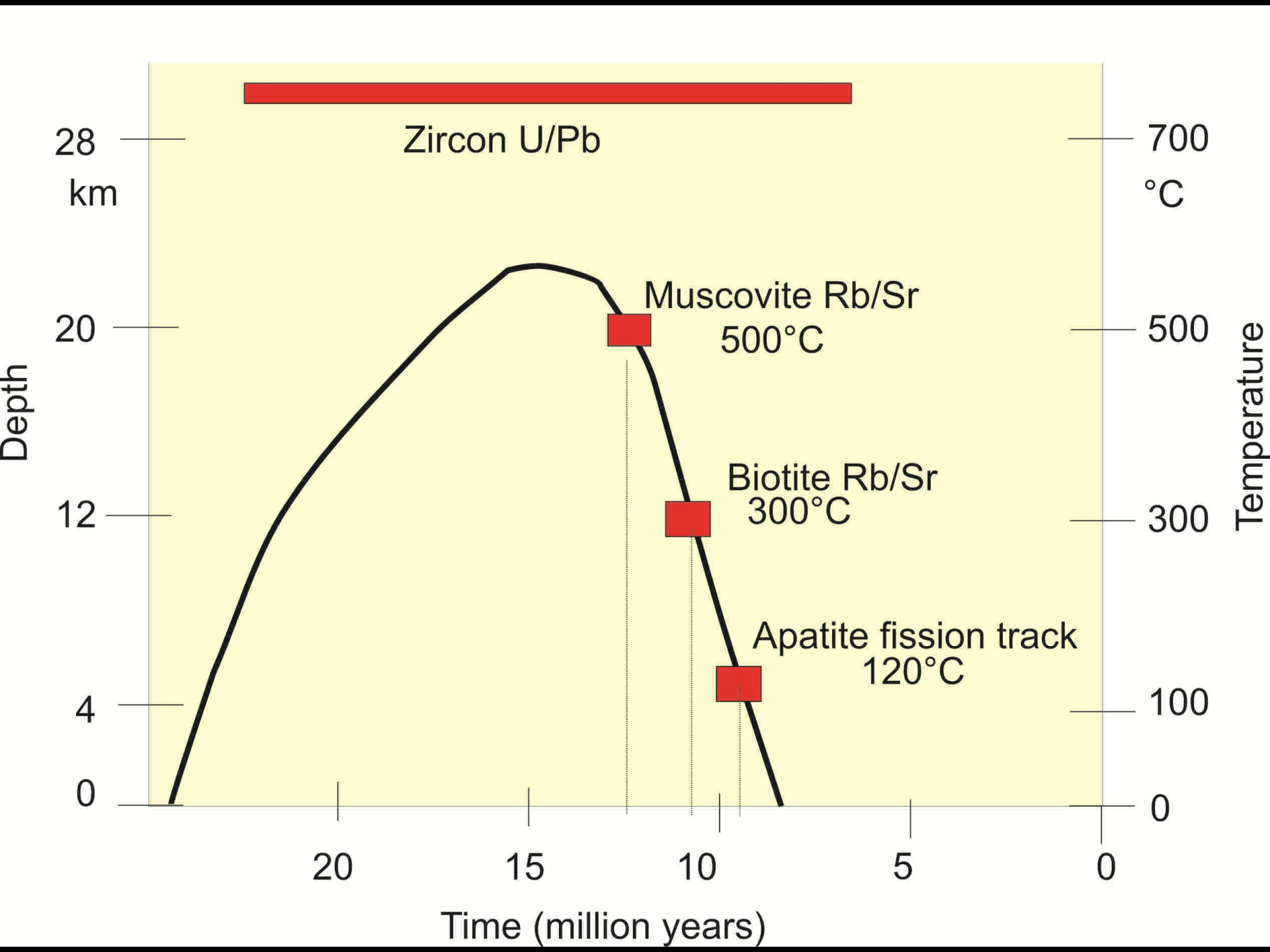


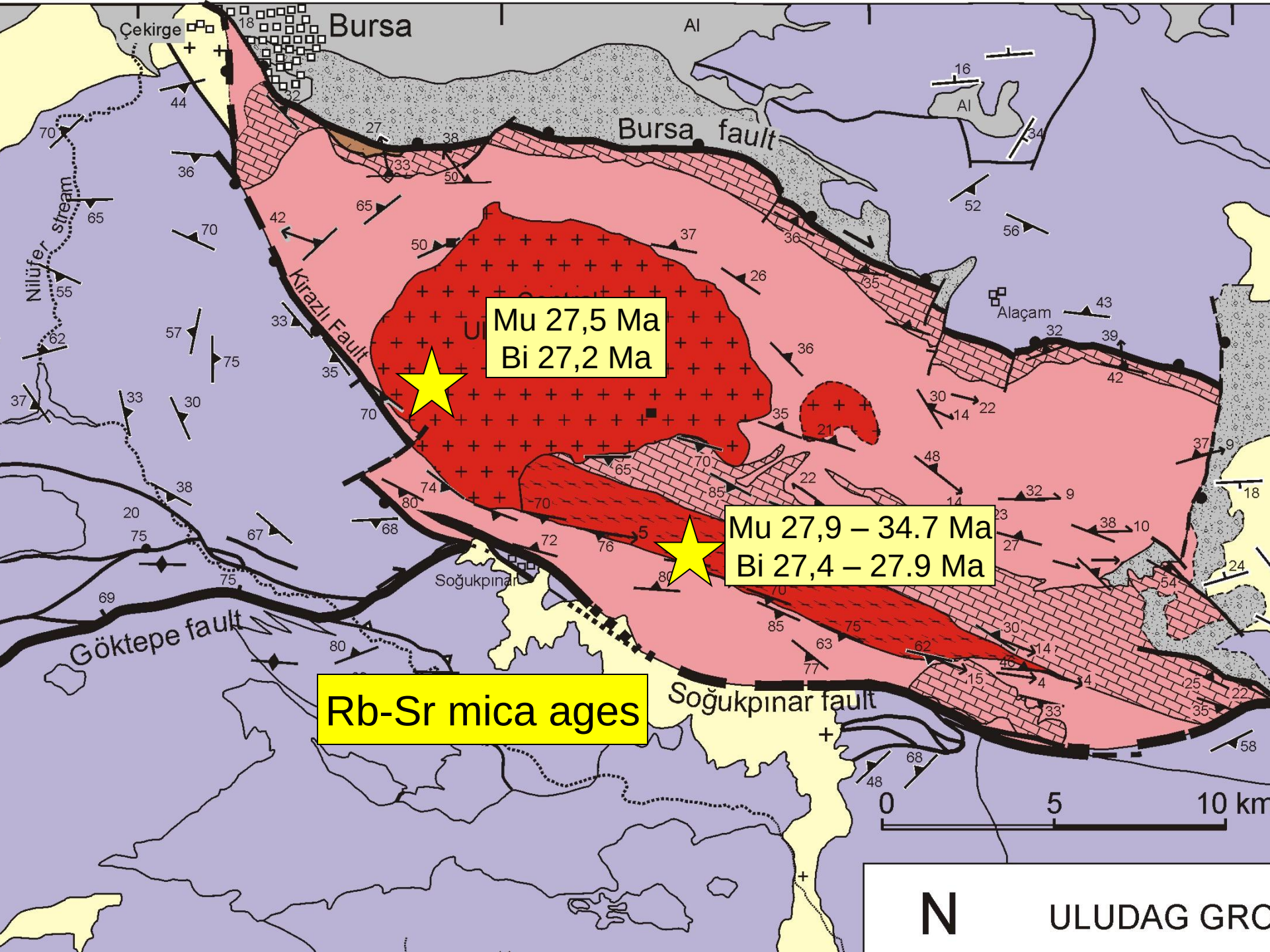


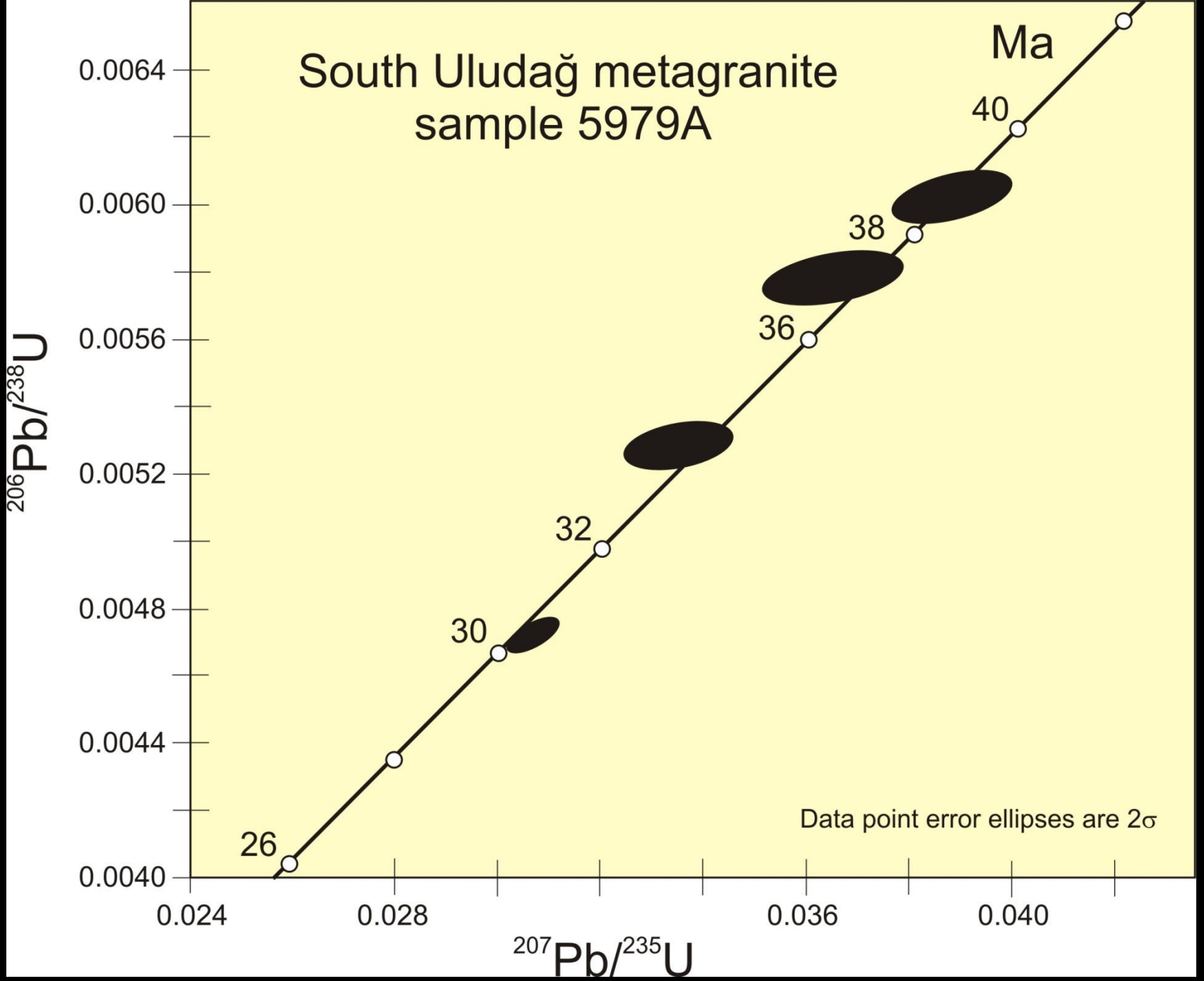


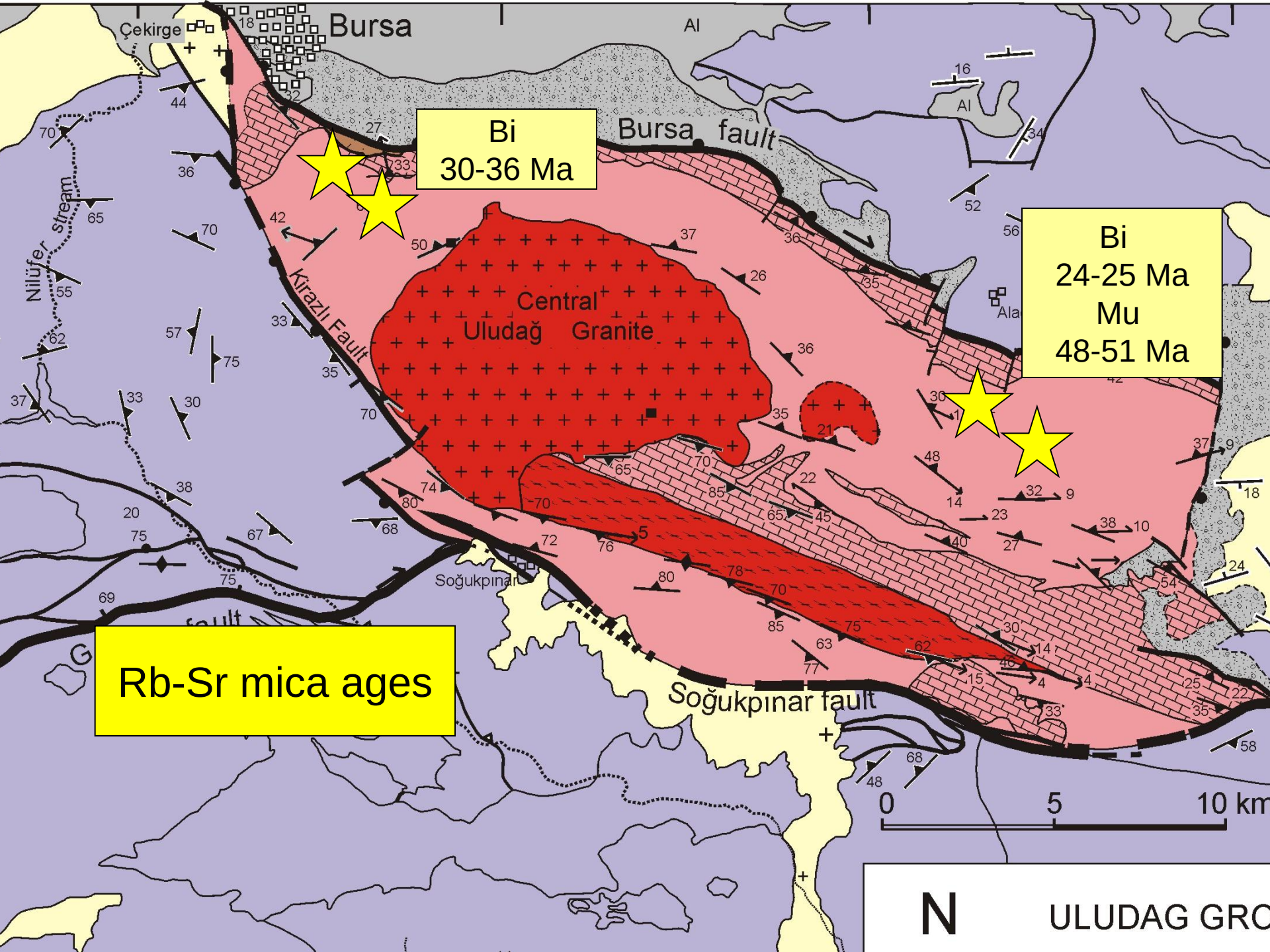
İzotopik değerler

Soğuma yaşları


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


Çekirge
Bursa
Al
Bursa fault
Nilüfer stream
Kirazlı Fault
Mu 27,5 Ma
Bi 27,2 Ma
Mu 27,9 – 34.7 Ma
Bi 27,4 – 27.9 Ma
Alaçam
Soğukpınar
Göktepe fault
Soğukpınar fault
Rb-Sr mica ages
0
5
10 km
N
ULUDAG GRO


South Uludağ metagranite
sample 5979A
Ma
40
38
36
32
30
26
0.0064
0.0060
0.0056
0.0052
0.0048
0.0044
0.0040
$^{206}Pb/^{238}U$
0.024
0.028
0.036
0.040
$^{207}Pb/^{235}U$
Data point error ellipses are 2σ


Çekirge
Bursa
Al
Bursa fault
Bi
30-36 Ma
Bi
24-25 Ma
Mu
48-51 Ma
Nilüfer stream
Kirazlı Fault
Central
Uludağ Granite
Soğukpınar
Soğukpınar fault
Rb-Sr mica ages
0
5
10 km
N
ULUDAG GRO

Uludağ Masifi – Oligosen yaşında sünek makaslama zonu

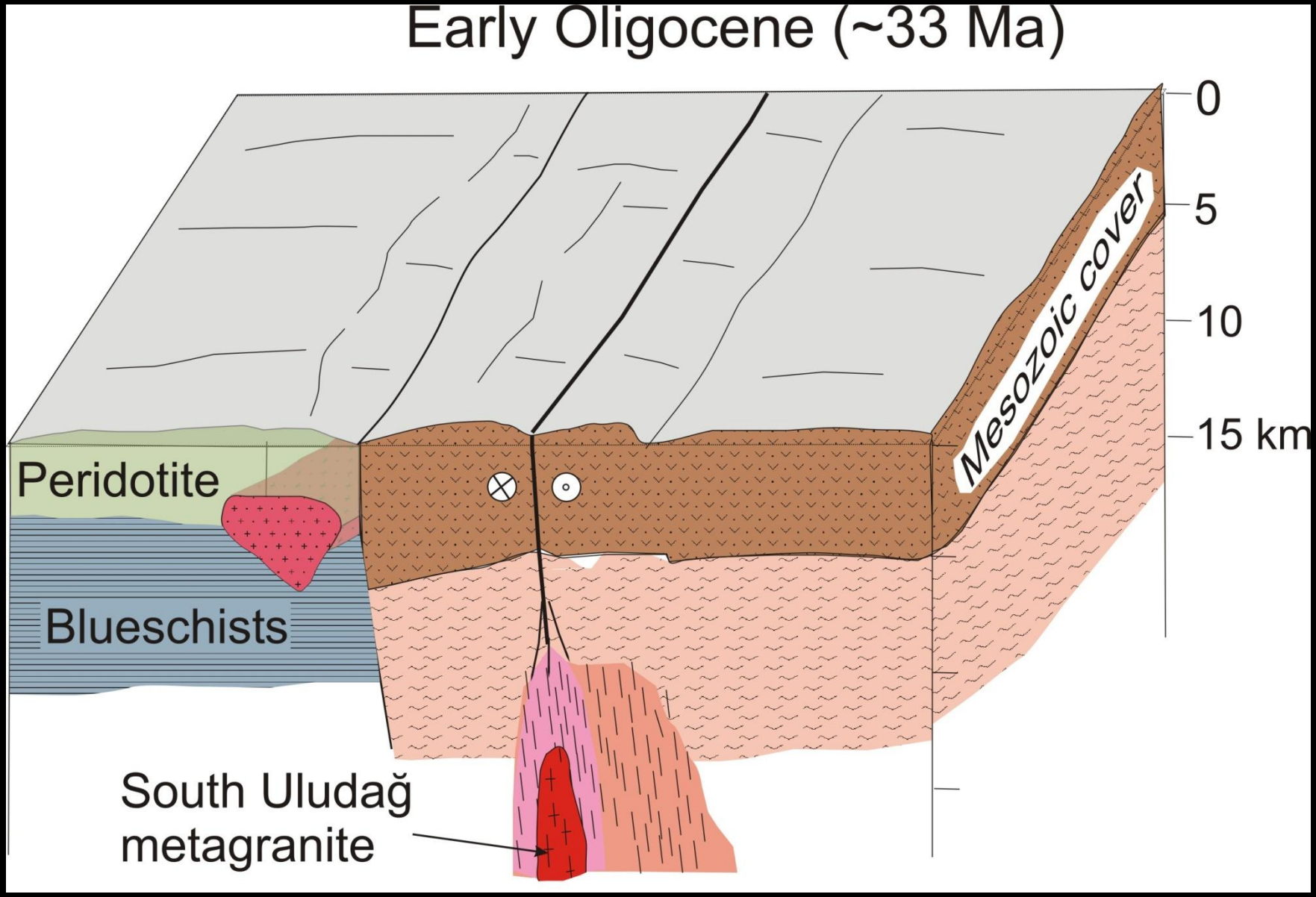
-Yataya yakın mineral uzama lineasyonları

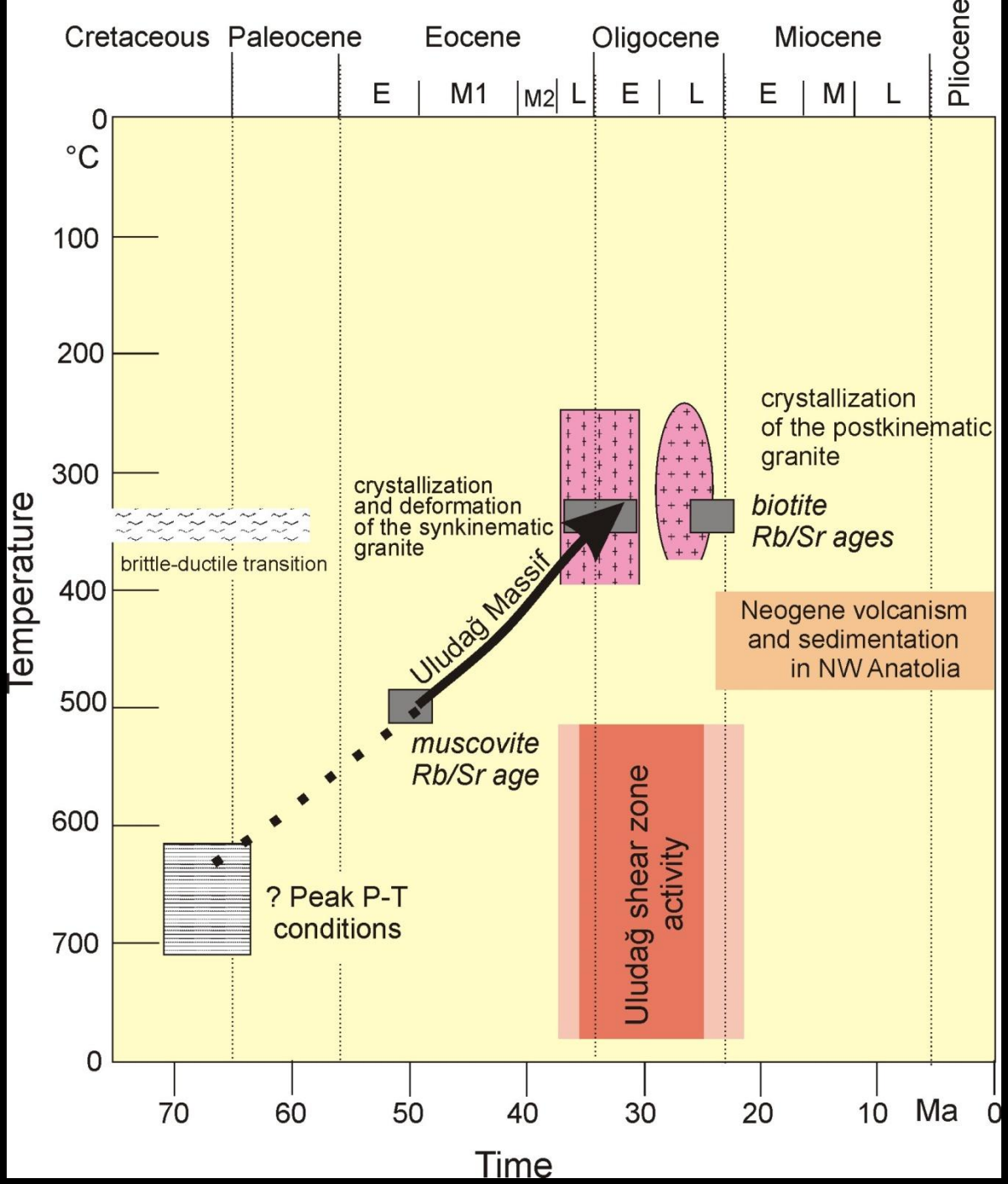
- Deformasyon ile eşyaşlı, levhamsı Oligosen graniti

- Gnaysik yapraklanma - sabit doğrultu, dikçe eğim

- Lineasyonun, yapraklanma doğrultusunun, granitin ekseninin, Uludağ silsilesinin ve Eskişehir Fayı'nın birbirlerine paralel uzanmaları

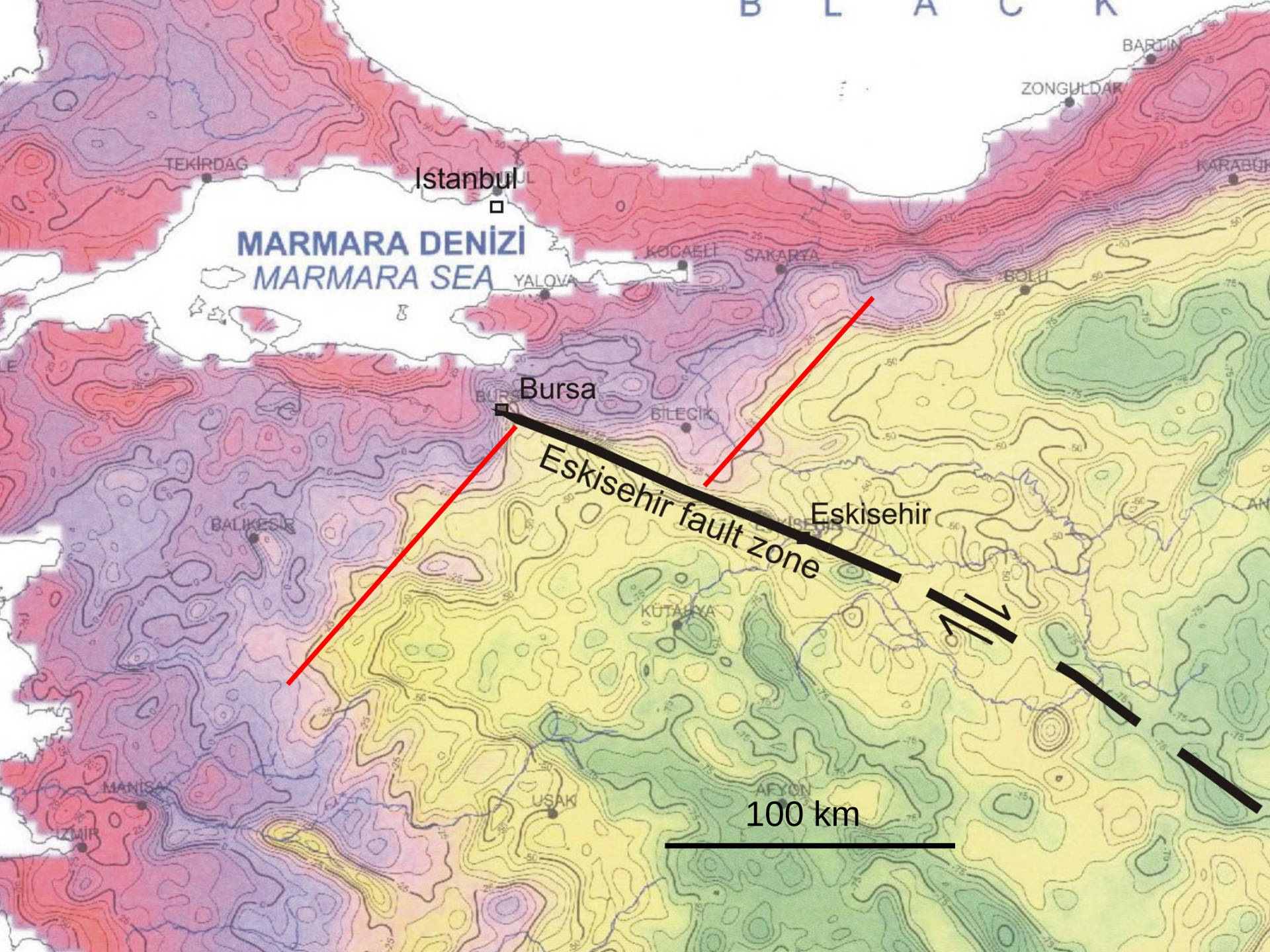
- Eskişehir Fayı'nın ucundaki konumu

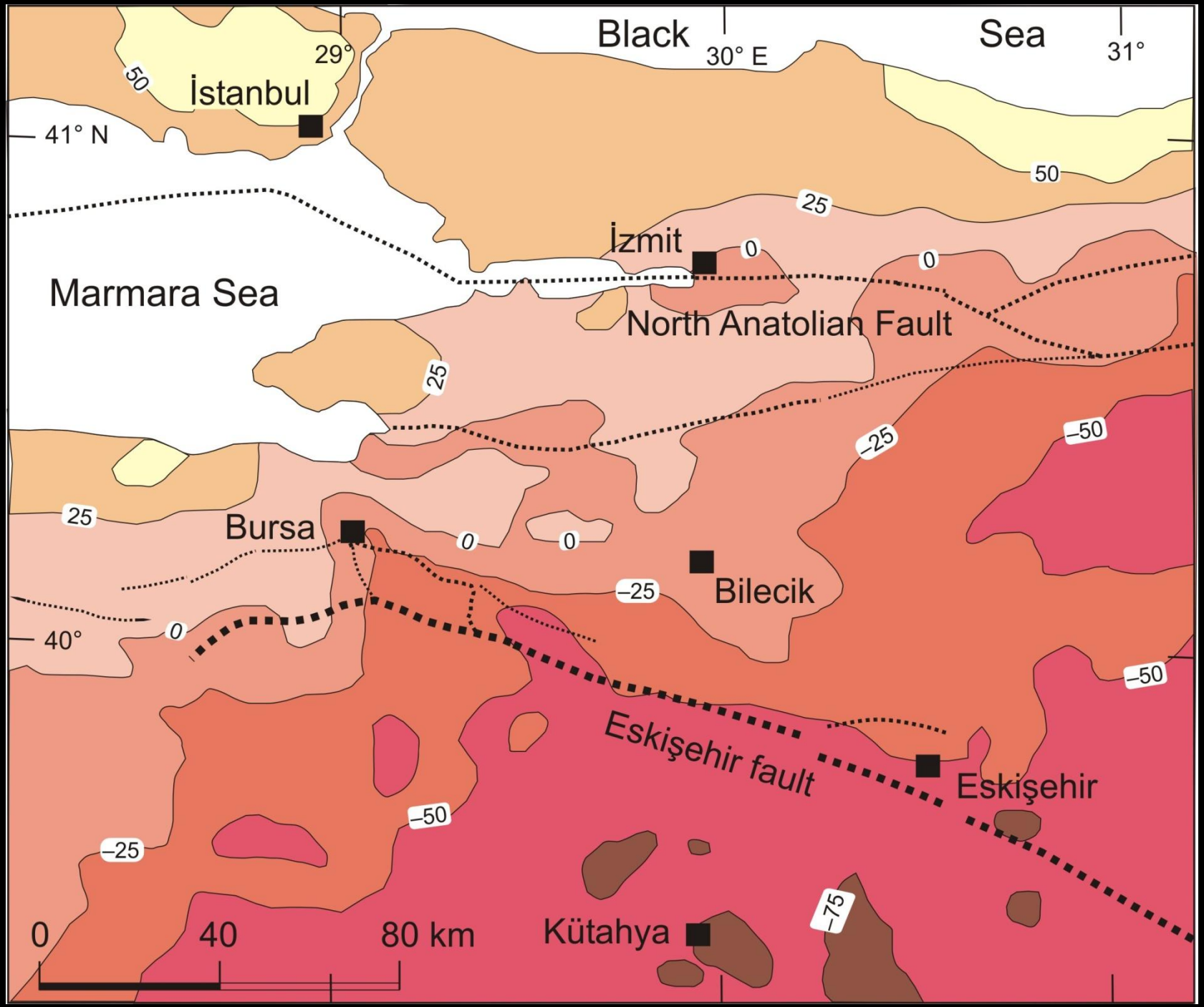

Early Oligocene (~33 Ma)
0
5
10
15 km
Mesozoic cover
Peridotite
Blueschists
South Uludağ
metagranite

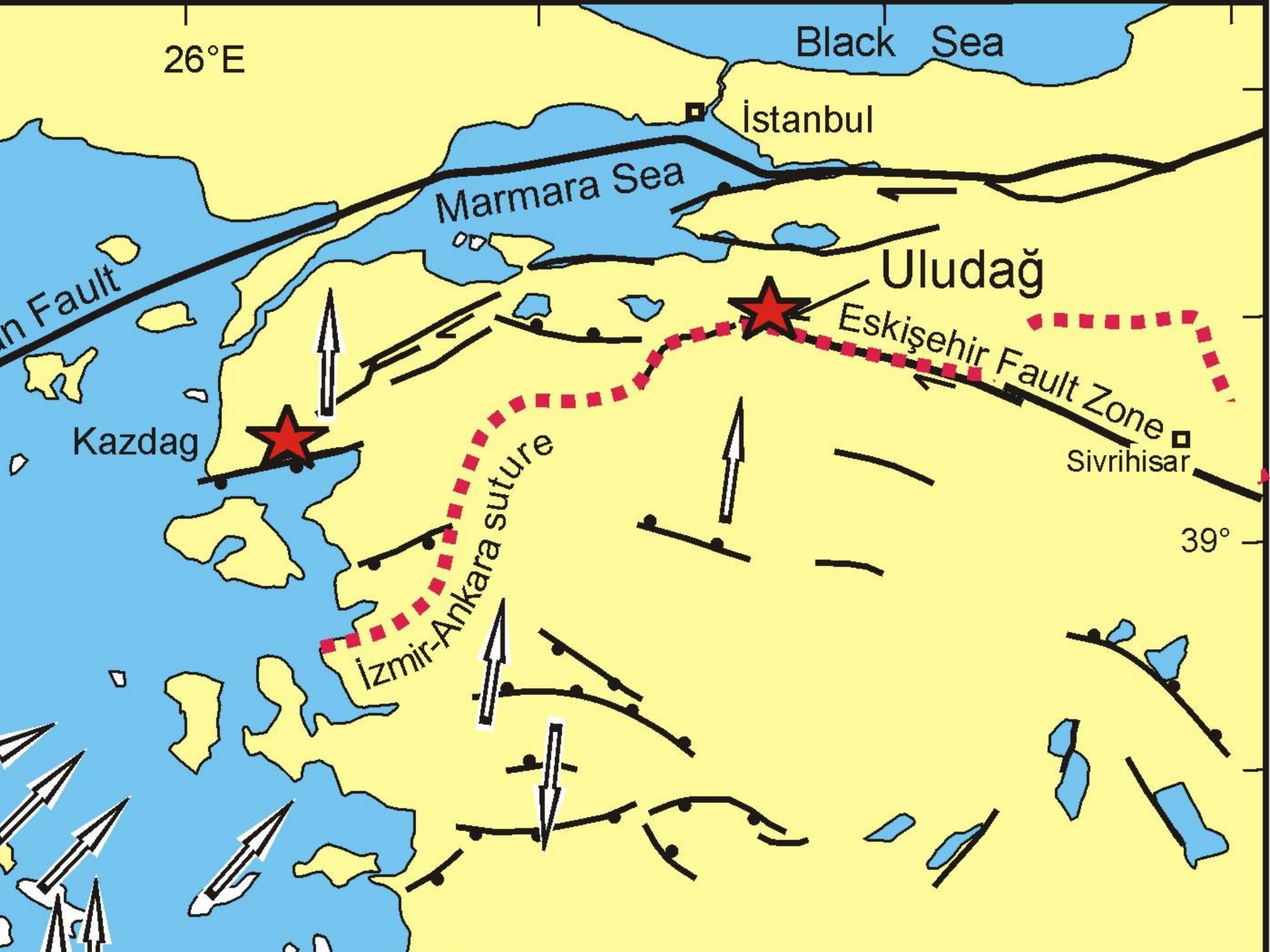

Cretaceous
Paleocene
Eocene
Oligocene
Miocene
Pliocene
E
M1
M2
L
E
L
E
M
L
0
°C
100
200
300
400
500
600
700
0
Temperature
brittle-ductile transition
crystallization
and deformation
of the synkinematic
granite
Uludağ Massif
crystallization
of the postkinematic
granite
biotite
Rb/Sr ages
Neogene volcanism
and sedimentation
in NW Anatolia
muscovite
Rb/Sr age
Uludağ shear zone
activity
? Peak P-T
conditions
70
60
50
40
30
20
10
Ma
0
Time

Uludağ makaslama zonu

- Toplam atım miktarı ne kadar?


B L A C K
BARTIN
ZONGULDAK
TEKIRDAG
Istanbul
MARMARA DENİZİ
MARMARA SEA
KOCAELİ
SAKARYA
YALOVA
BOLU
Bursa
BİLECİK
Eskisehir fault zone
Eskisehir
BALIKESIR
KUTAHYA
MANISA
IZMIR
USAK
AFYON
100 km

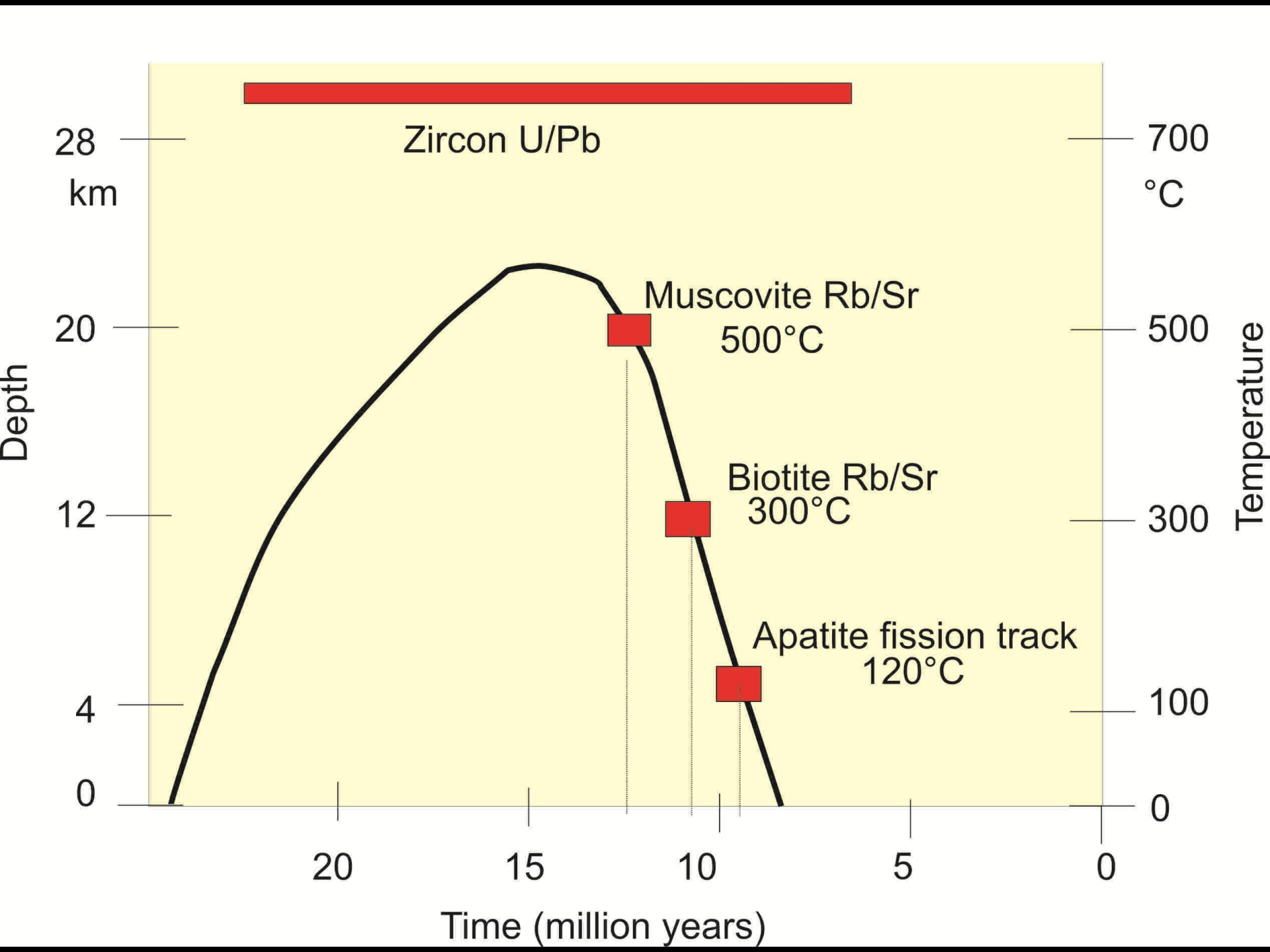

Black Sea
29°
30° E
31°
İstanbul
41° N
50
50
25
İzmit
0
0
Marmara Sea
North Anatolian Fault
25
–25
–50
25
Bursa
0
0
Bilecik
–25
40°
0
–50
Eskişehir fault
Eskişehir
–50
–25
–75
Kütahya
0
40
80 km

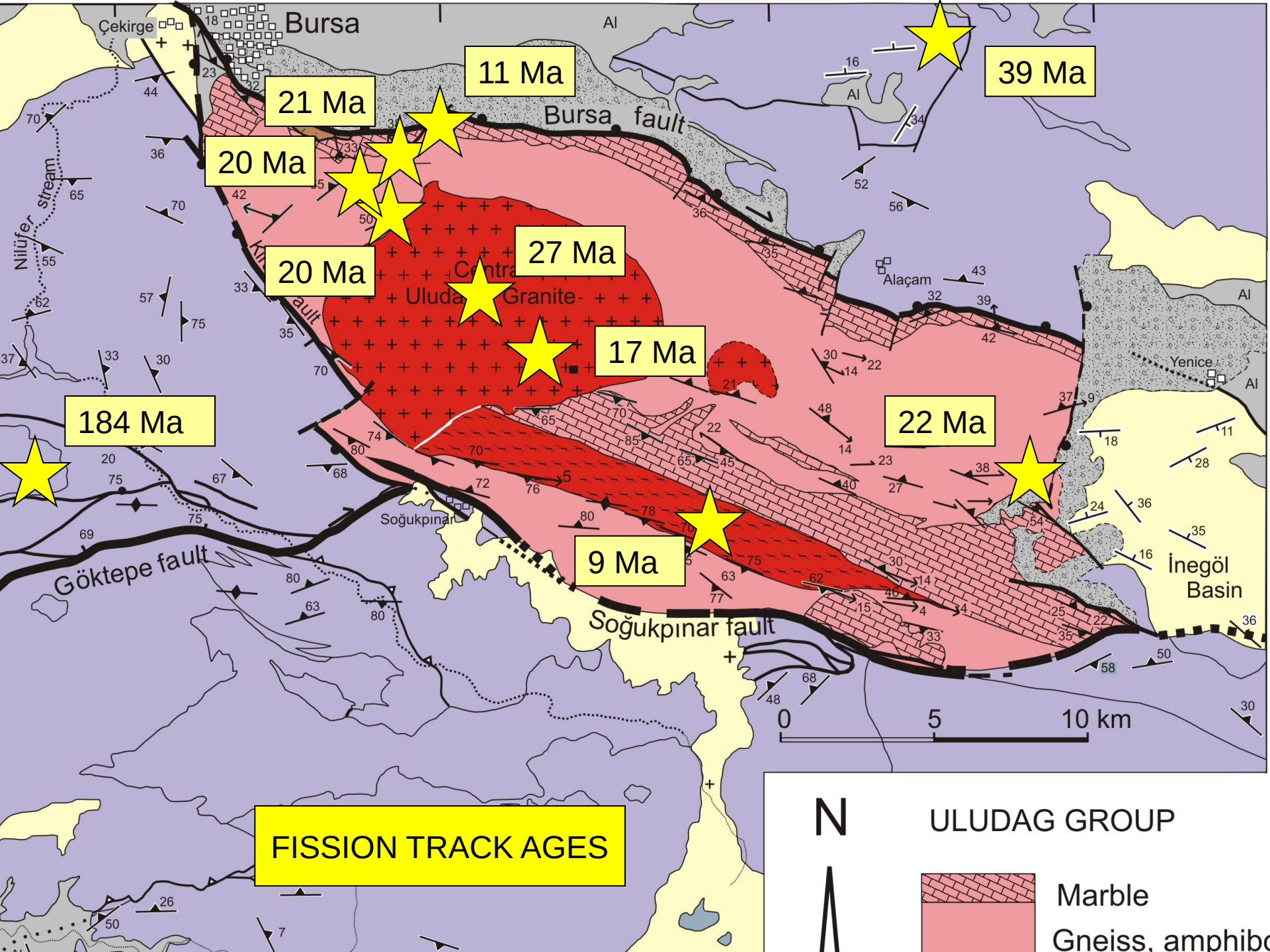

26°E
Black Sea
İstanbul
Marmara Sea
n Fault
Uludağ
Eskişehir Fault Zone
Sivrihisar
Kazdag
İzmir-Ankara suture
39°

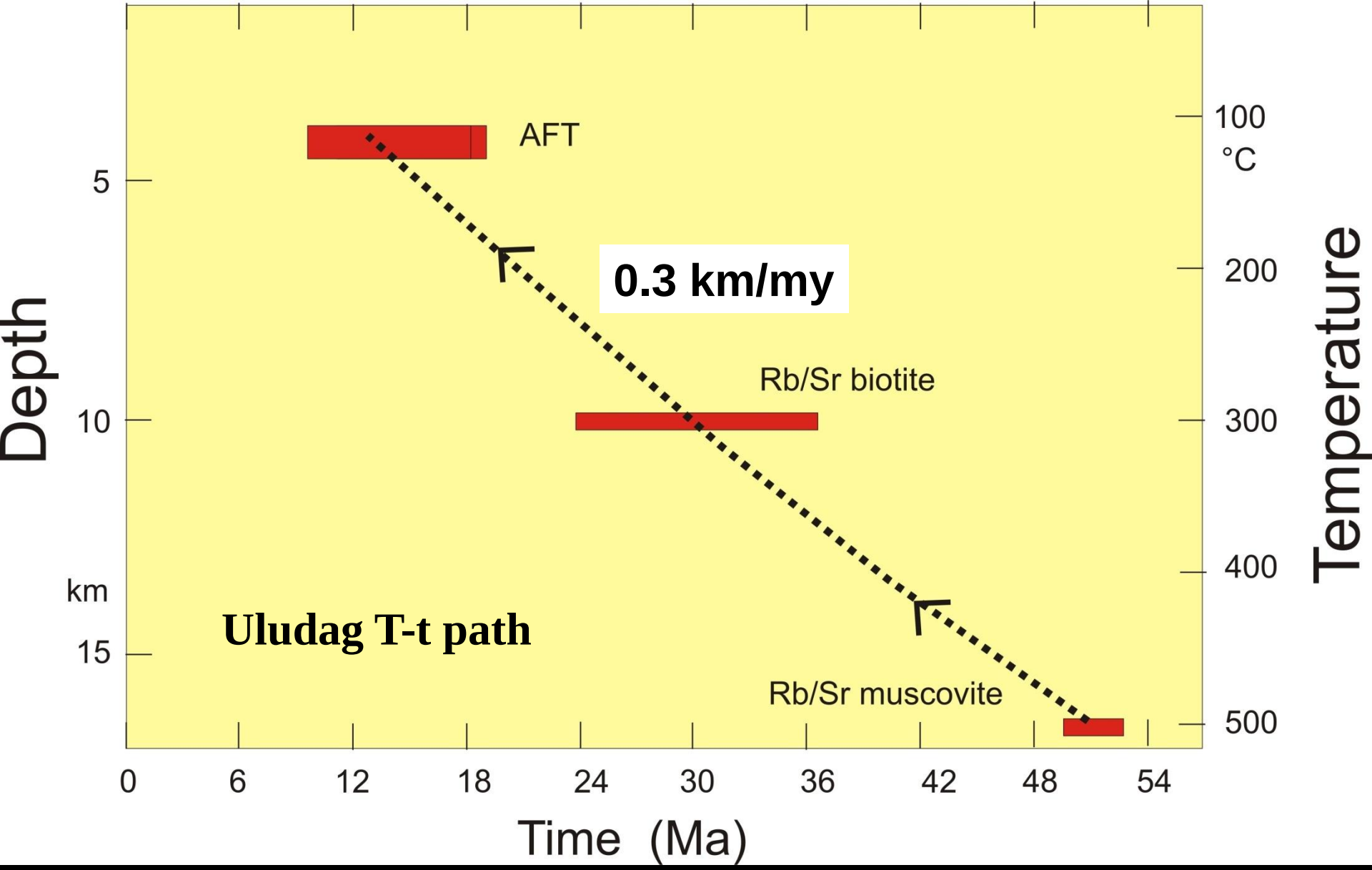
Uludağ makaslama zonu / Eskişehir Fayı'nda toplam atım miktarı ~100 km; batıya doğru azalıyor.

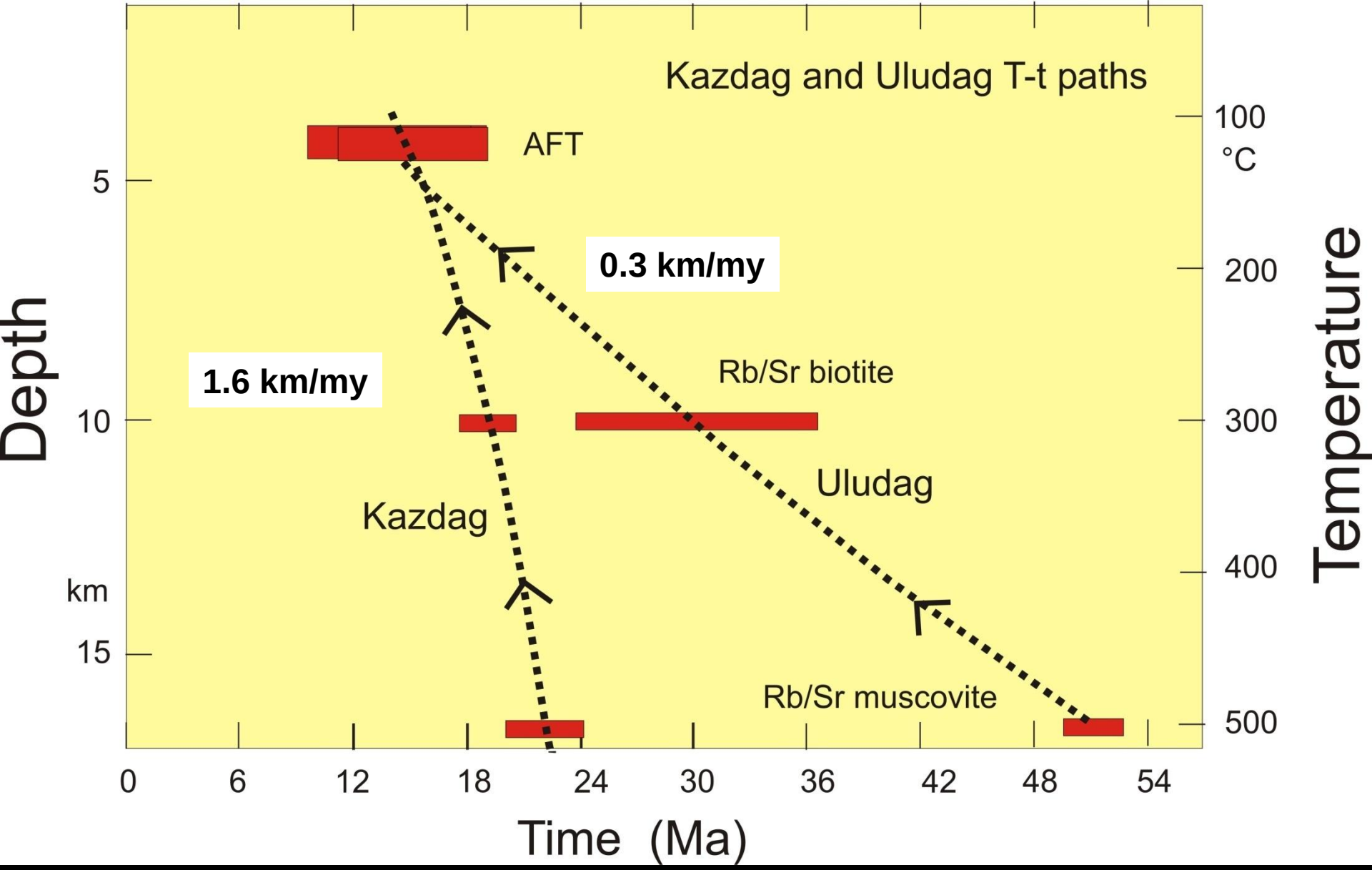
Uludağ makaslama zonu

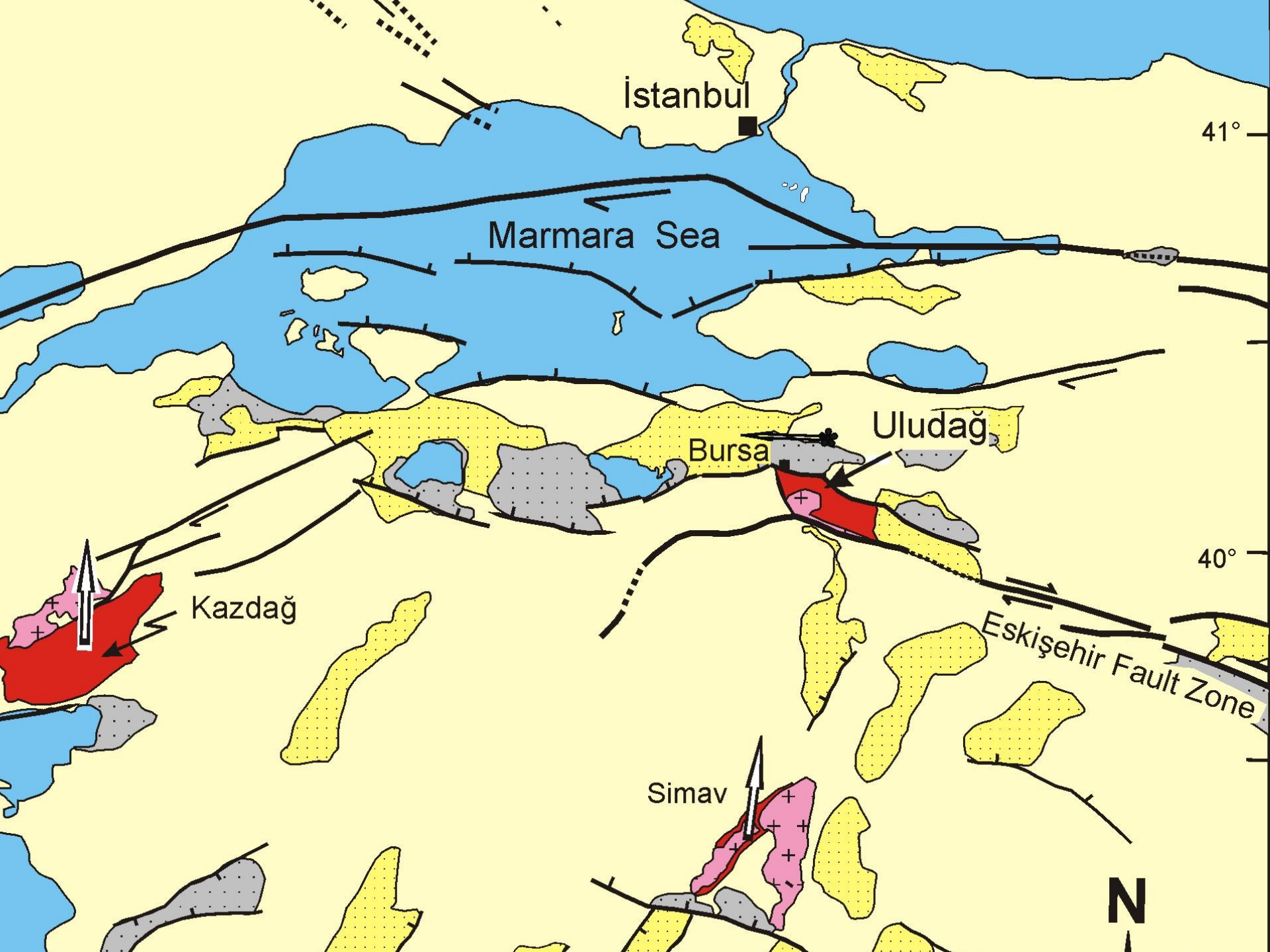
- Ne zaman ve nasıl satha yükseldi?

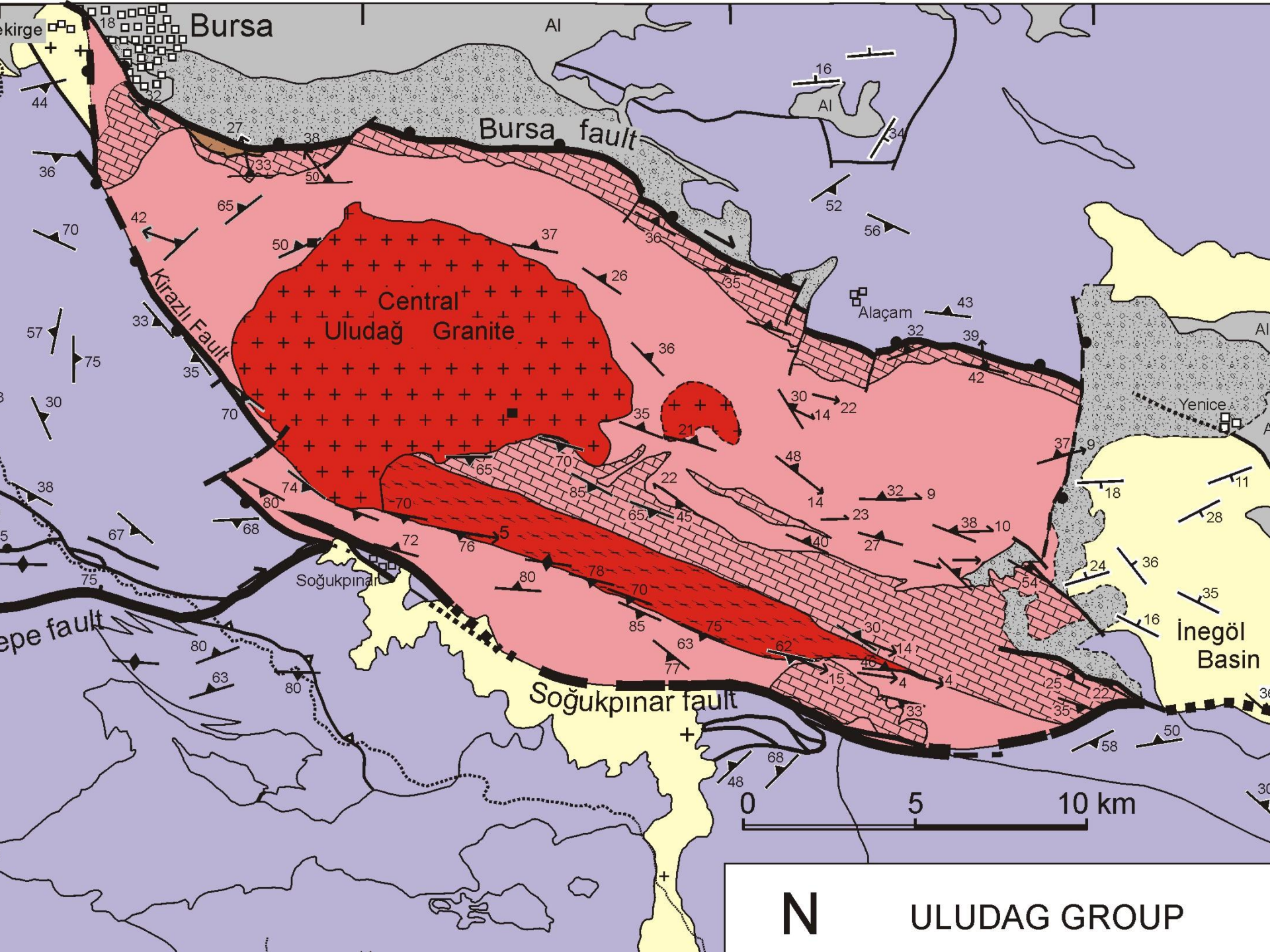

Zircon U/Pb
Muscovite Rb/Sr
500°C
Biotite Rb/Sr
300°C
Apatite fission track
120°C
28
km
20
12
4
0
Depth
700
°C
500
300
100
0
Temperature
20
15
10
5
0
Time (million years)


Çekirge
Bursa
Al
11 Ma
21 Ma
39 Ma
Bursa fault
20 Ma
Nilüfer stream
27 Ma
20 Ma
Uluda Granite
Alaçam
Al
17 Ma
Yenice
Al
184 Ma
22 Ma
Soğukpınar
9 Ma
Göktepe fault
İnegöl Basin
Soğukpınar fault
0
5
10 km
FISSION TRACK AGES
N
ULUDAG GROUP
Marble
Gneiss, amphibo


AFT
0.3 km/my
Rb/Sr biotite
Rb/Sr muscovite
Uludag T-t path
Depth
km
5
10
15
Temperature
°C
100
200
300
400
500
0
6
12
18
24
30
36
42
48
54
Time (Ma)

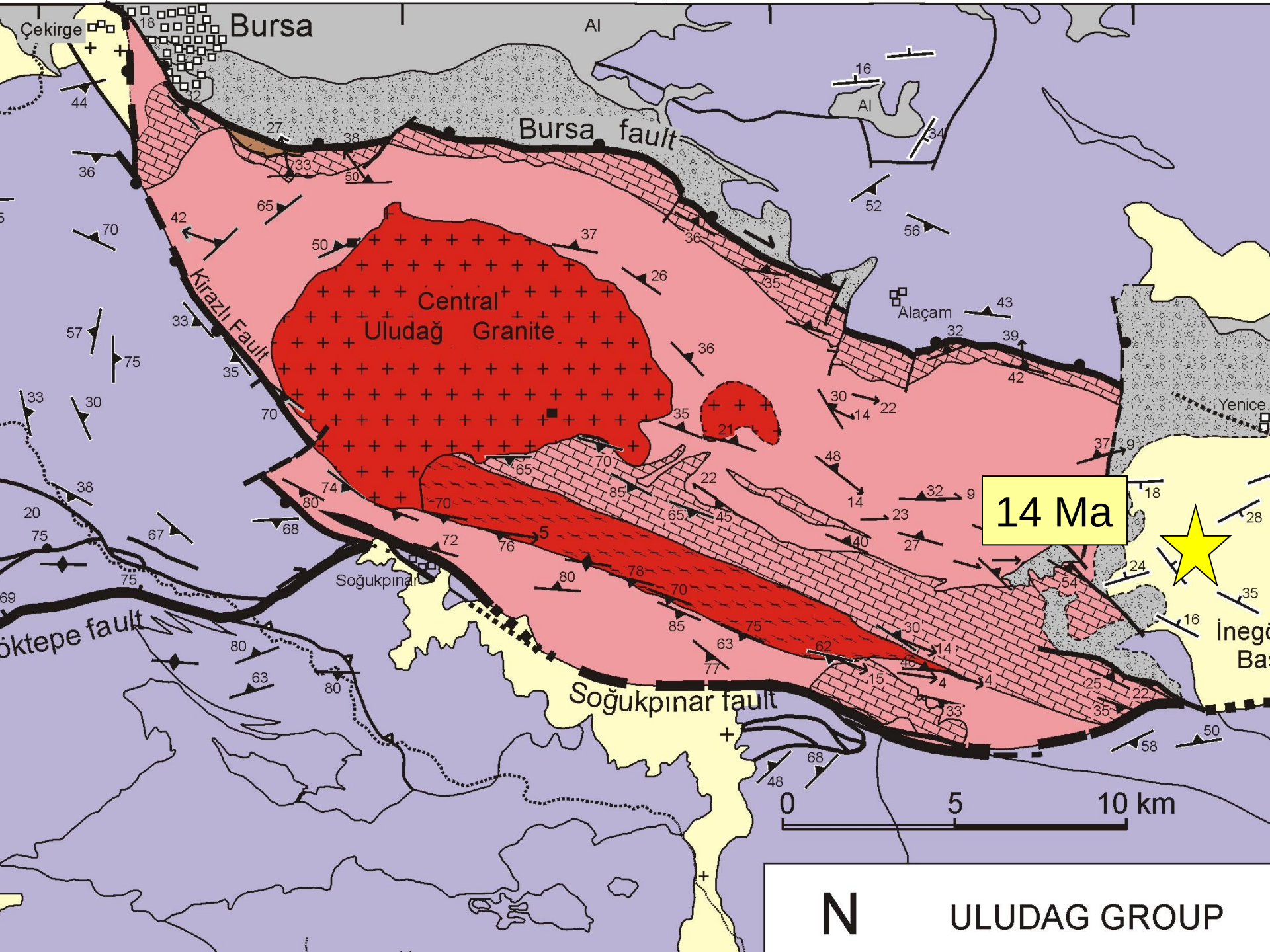

Kazdag and Uludag T-t paths
AFT
0.3 km/my
1.6 km/my
Rb/Sr biotite
Uludag
Kazdag
Rb/Sr muscovite
Depth
km
5
10
15
Temperature
°C
100
200
300
400
500
0
6
12
18
24
30
36
42
48
54
Time (Ma)

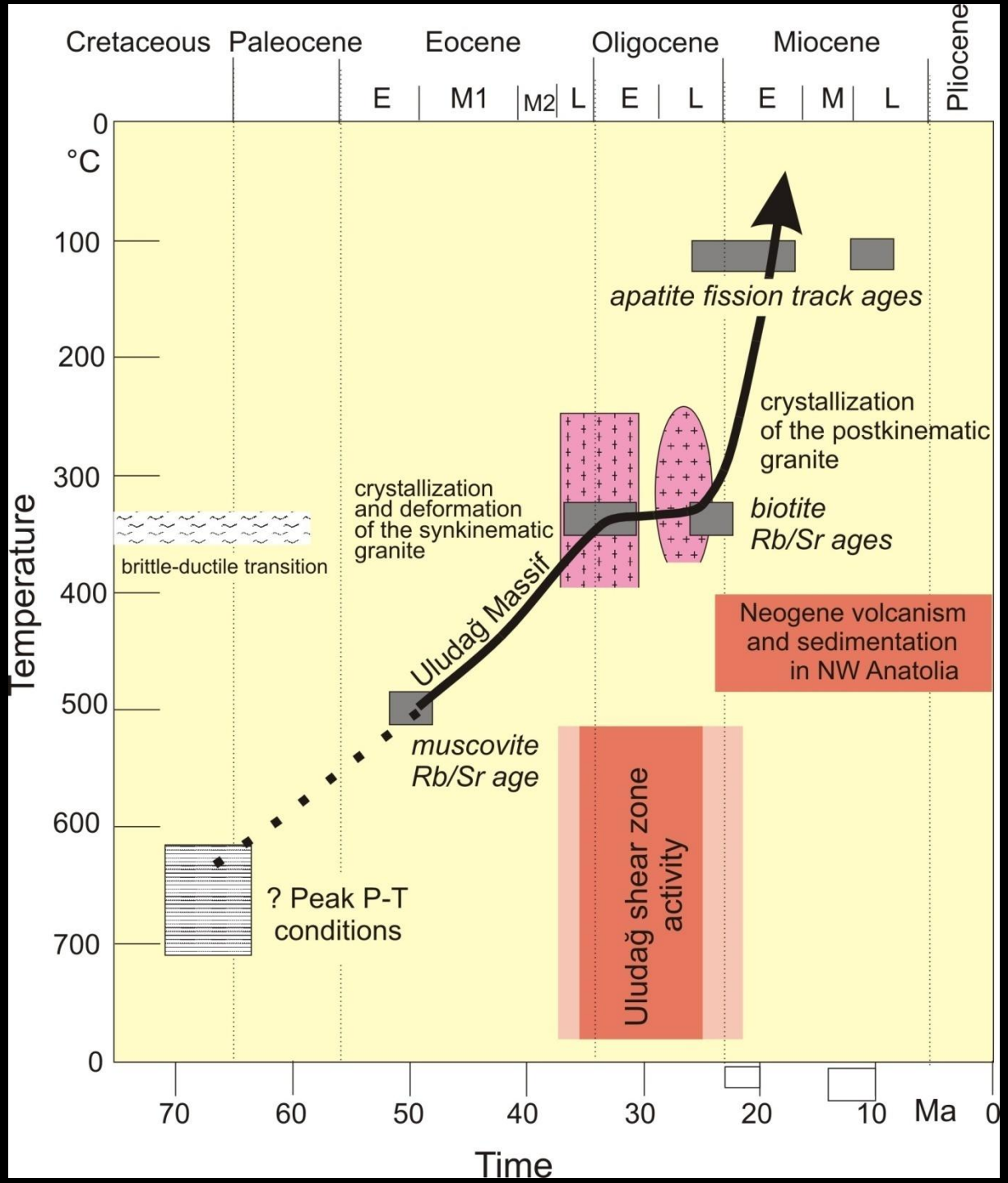

İstanbul
41°
Marmara Sea
Uludağ
Bursa
40°
Kazdağ
Eskişehir Fault Zone
Simav
N

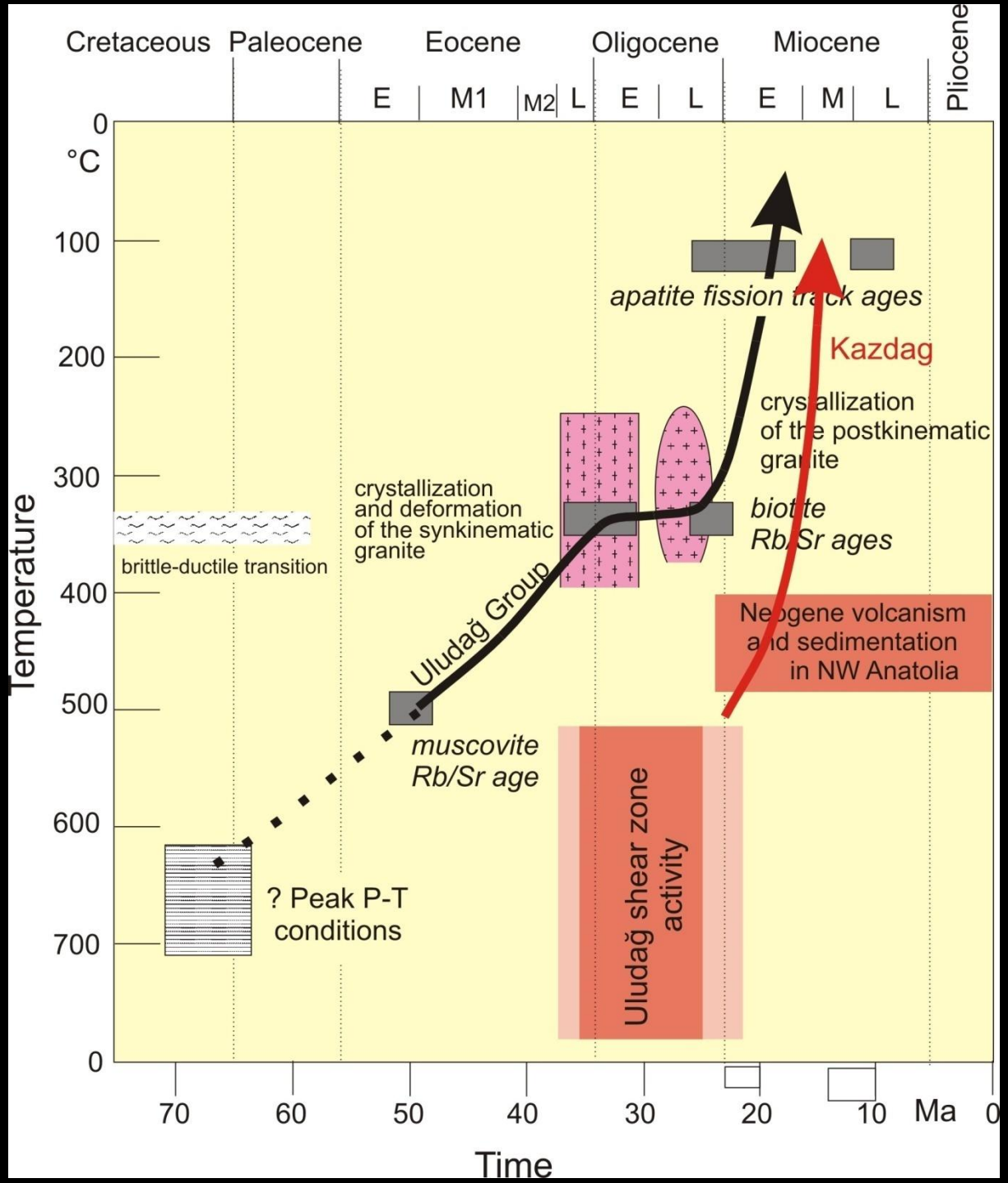

Bursa
Al
Bursa fault
Kirazlı Fault
Central
Uludağ Granite
Alaçam
Yenice
İnegöl
Basin
Soğukpınar
Soğukpınar fault
epe fault
0
5
10 km
N
ULUDAG GROUP

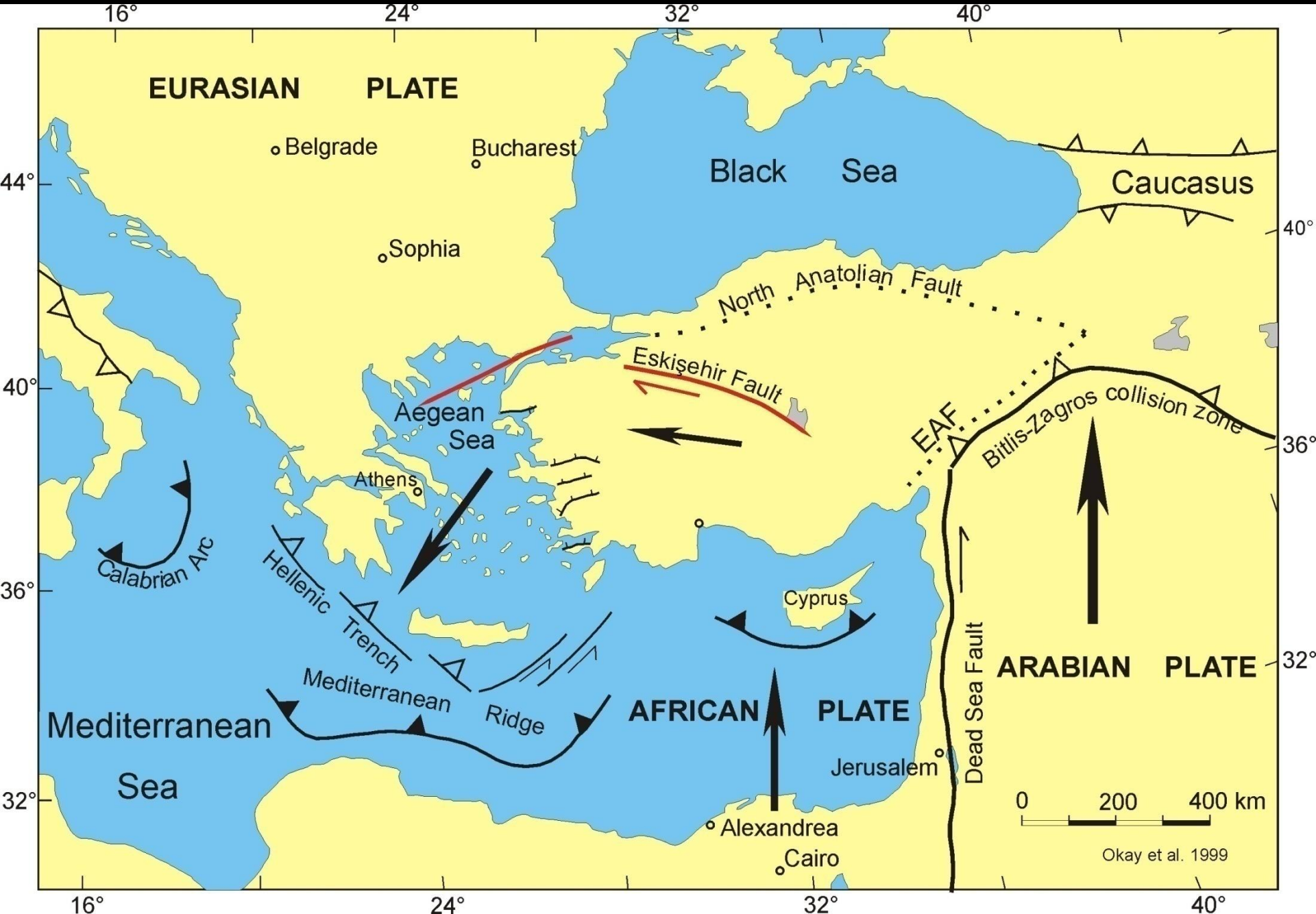





Çekirge
Bursa
Al
Bursa fault
Kirazlı Fault
Central
Uludağ Granite
Alaçam
Yenice
14 Ma
Soğukpınar
Soğukpınar fault
öktepe fault
İnegö
Bas
0
5
10 km
N
ULUDAG GROUP


Cretaceous
Paleocene
Eocene
Oligocene
Miocene
Pliocene
E
M1
M2
L
E
L
E
M
L
0
°C
100
200
300
400
500
600
700
0
Temperature
apatite fission track ages
crystallization
of the postkinematic
granite
biotite
Rb/Sr ages
crystallization
and deformation
of the synkinematic
granite
brittle-ductile transition
Uludağ Massif
Neogene volcanism
and sedimentation
in NW Anatolia
muscovite
Rb/Sr age
Uludağ shear zone
activity
? Peak P-T
conditions
70
60
50
40
30
20
10
Ma
0
Time


Cretaceous
Paleocene
Eocene
Oligocene
Miocene
Pliocene
E
M1
M2
L
E
L
E
M
L
0
°C
100
200
300
400
500
600
700
0
Temperature
apatite fission track ages
Kazdag
crystallization of the postkinematic granite
biotite Rb/Sr ages
crystallization and deformation of the synkinematic granite
brittle-ductile transition
Uludağ Group
Neogene volcanism and sedimentation in NW Anatolia
muscovite Rb/Sr age
Uludağ shear zone activity
? Peak P-T conditions
70
60
50
40
30
20
10
Ma
0
Time


16°
24°
32°
40°
EURASIAN PLATE
Belgrade
Bucharest
Black Sea
Caucasus
44°
Sophia
North Anatolian Fault
40°
Eskişehir Fault
Aegean Sea
EAF
Bitlis-Zagros collision zone
Athens
36°
Calabrian Arc
Hellenic Trench
Cyprus
ARABIAN PLATE
Mediterranean Ridge
AFRICAN PLATE
Mediterranean Sea
Dead Sea Fault
Jerusalem
0 200 400 km
Alexandrea
Cairo
Okay et al. 1999

Sonuçlar

Uludağ Masifi Oligosen yaşında sağ yönlü doğrultu-atımlı bir fayın derindeki sünek kesimlerini temsil eder.

Eskişehir Fayı ile çakışan bu faydaki toplam atım miktarı ~100 km'dir.

Kazdağ ve Uludağ'ın satha yükselmesi Erken-Orta Miyosen'de genişlemeli bir tektonik rejim altında, Helenik hendeğinin güneye göçmesine bağlı.

Yamulma hızı sabit değil, Erken Miyosen'de yüksek, sonrası düşük

Oligosen'de Ege bölgesinde tektonik rejim günümüze benziyordu, batıda kuzey-güney yönlü genişleme, doğuda yanal atımlı fayla sınırlı blok tektoniği.

Anadolu levhasının batıya hareketi Oligosen'de başlamış olabilir.

Batıya hareketi sağlayan mekanizma Arabistan'ın çarpmasından ziyade Ege hendeğinin çekmesi.