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GPS study of N-S trending Karaburun Belt (Turkey) and its E-W trending eastern part

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OVERVIEW

1. Seismicity in Turkey
2. Study Area
3. Performing&Processing GPS Obs.
4. Discussion
5. Conclusions

MAP OF EARTHQUAKE REGIONS IN TURKEY

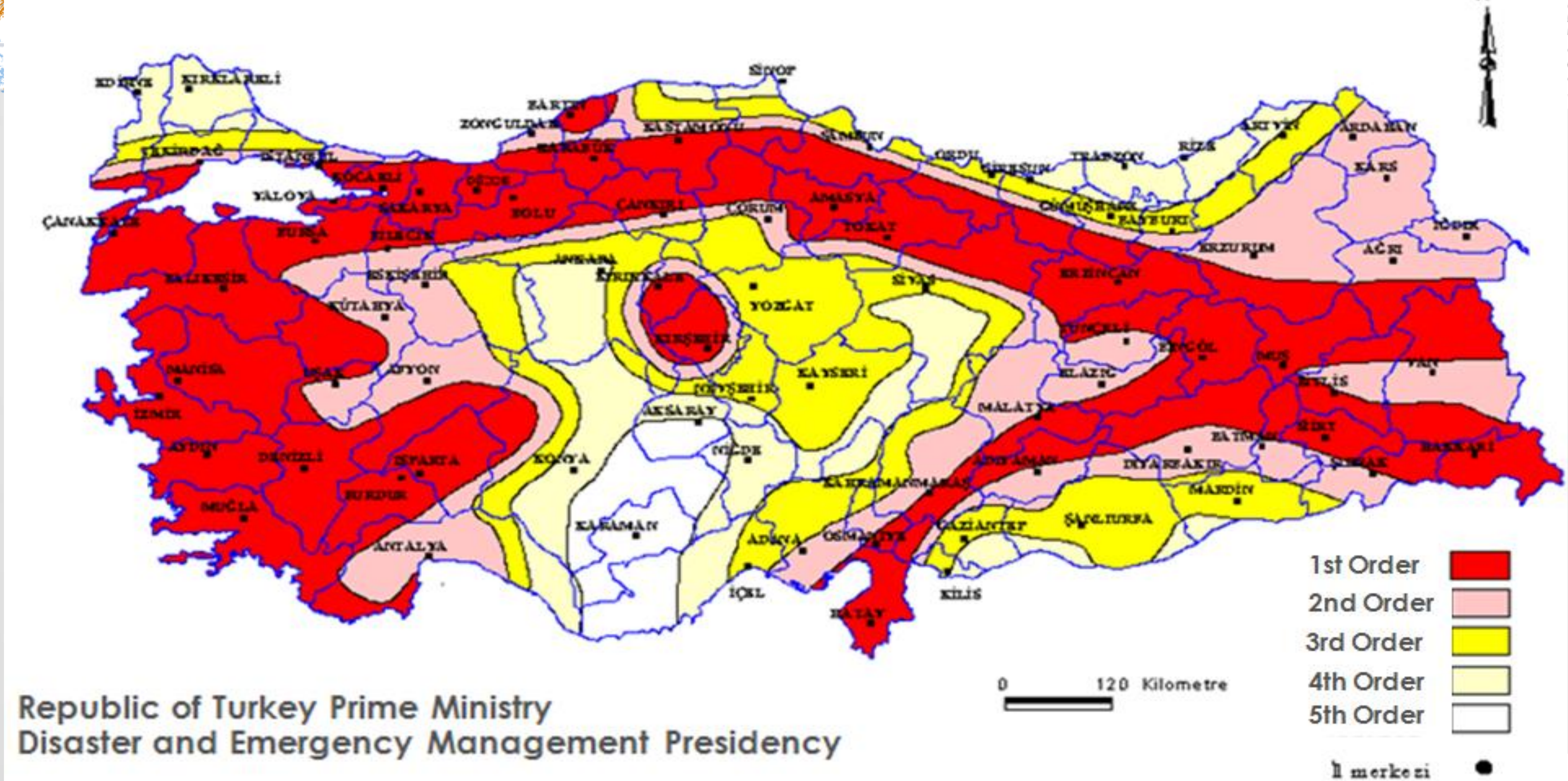
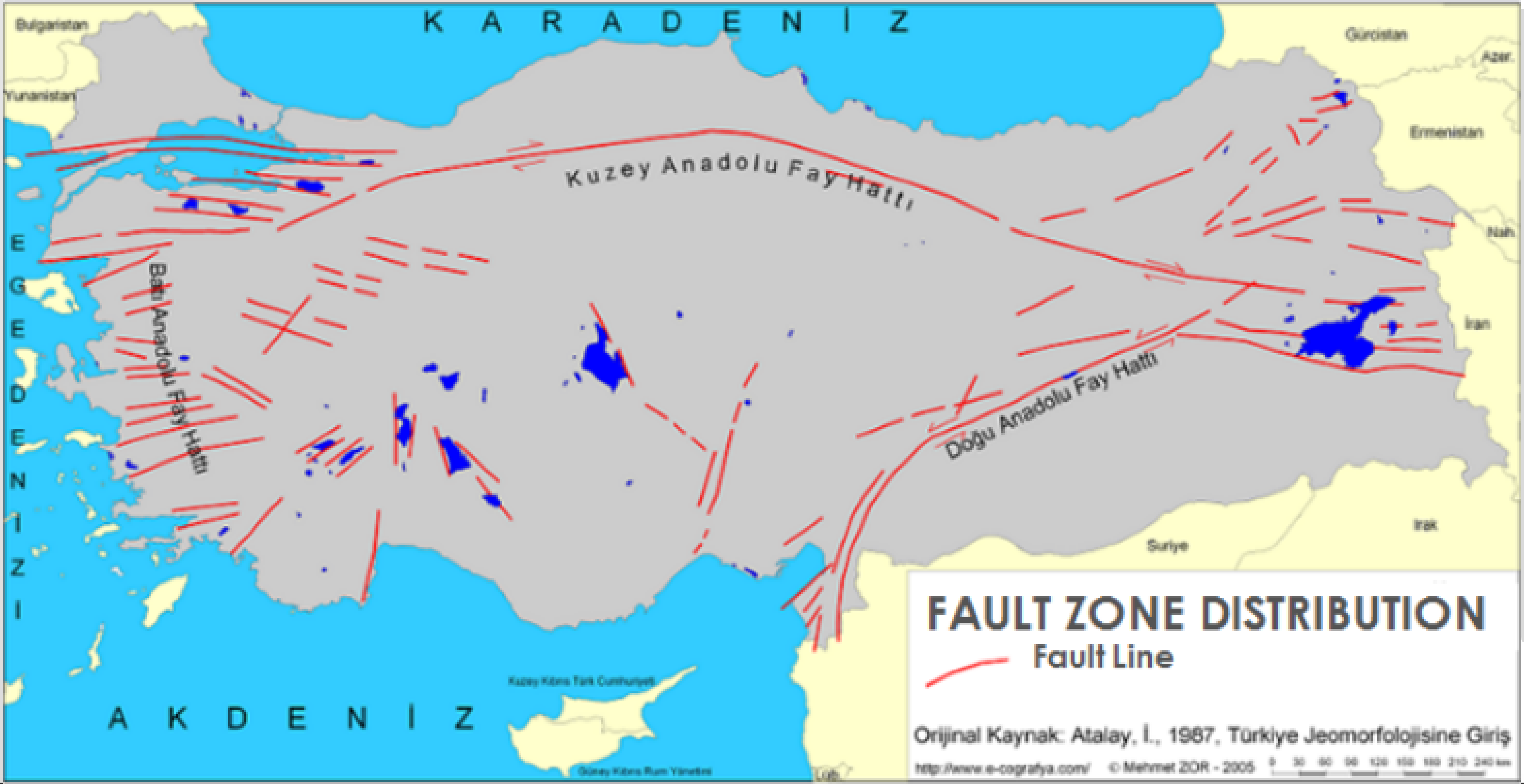


Figure 1. The map of Earthquake regions in Turkey

about 92% of Turkey is situated in earthquake regions


KARADENİZ
Bulgaristan
Yunanistan
Gürcistan
Azer.
Ermenistan
Nah.
İran
Irak
Suriye
EGE DENİZİ
AKDENİZ
Kuzey Anadolu Fay Hattı
Batı Anadolu Fay Hattı
Doğu Anadolu Fay Hattı
FAULT ZONE DISTRIBUTION
Fault Line
Orijinal Kaynak: Atalay, İ., 1987, Türkiye Jeomorfolojisine Giriş
http://www.e-cografya.com/
© Mehmet ZOR - 2005

STUDY AREA:

The study area which includes Karaburun (Belt) Peninsula and its surrounding locates in İzmir city and Western Anatolia.

The Western Anatolia is one of the most active extensional regions in the world.

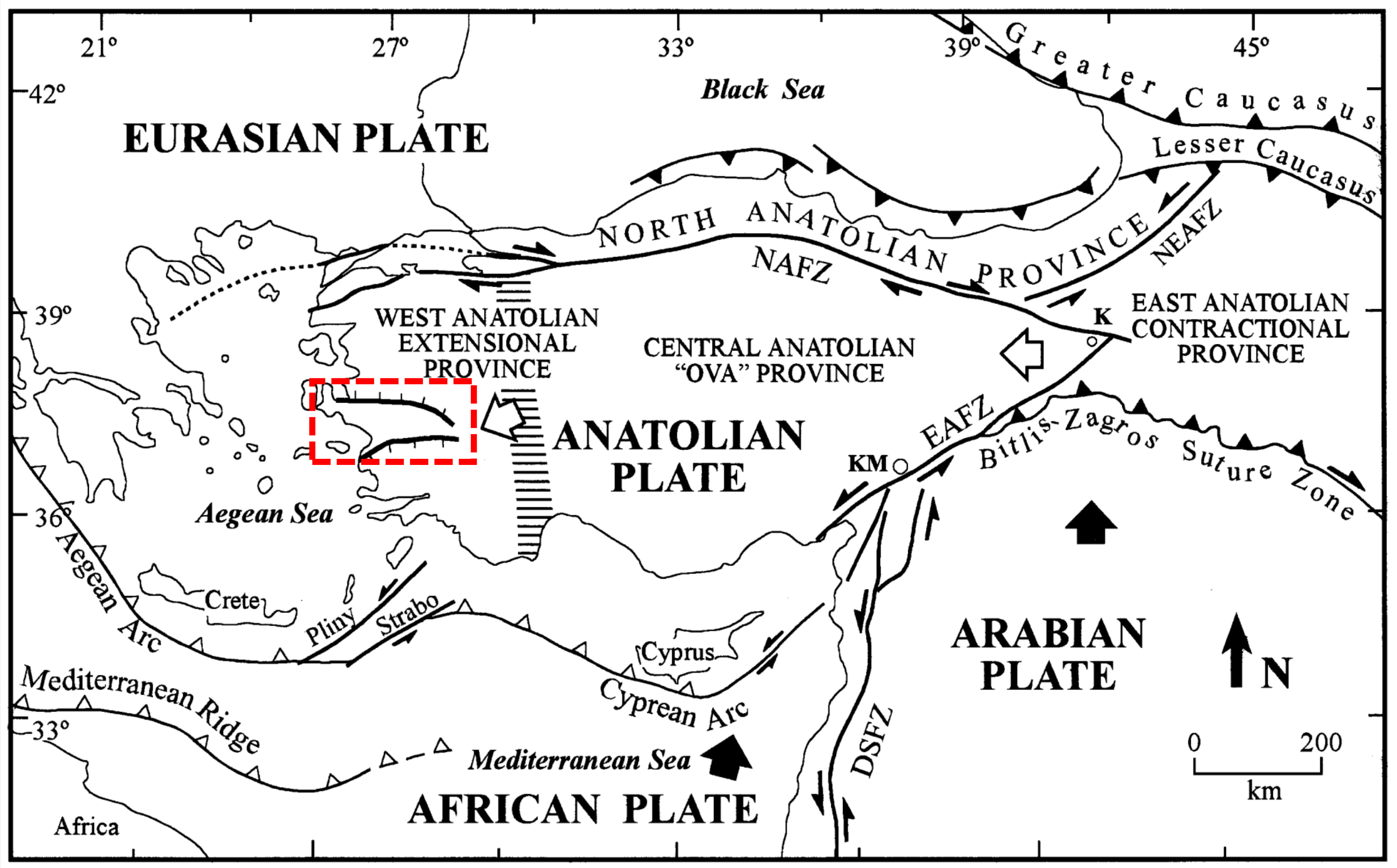


Figure 2. Simplified tectonic map of Turkey showing major neotectonic structures and neotectonic provinces (Bozkurt, 2001) The red rectangle represents the study area.

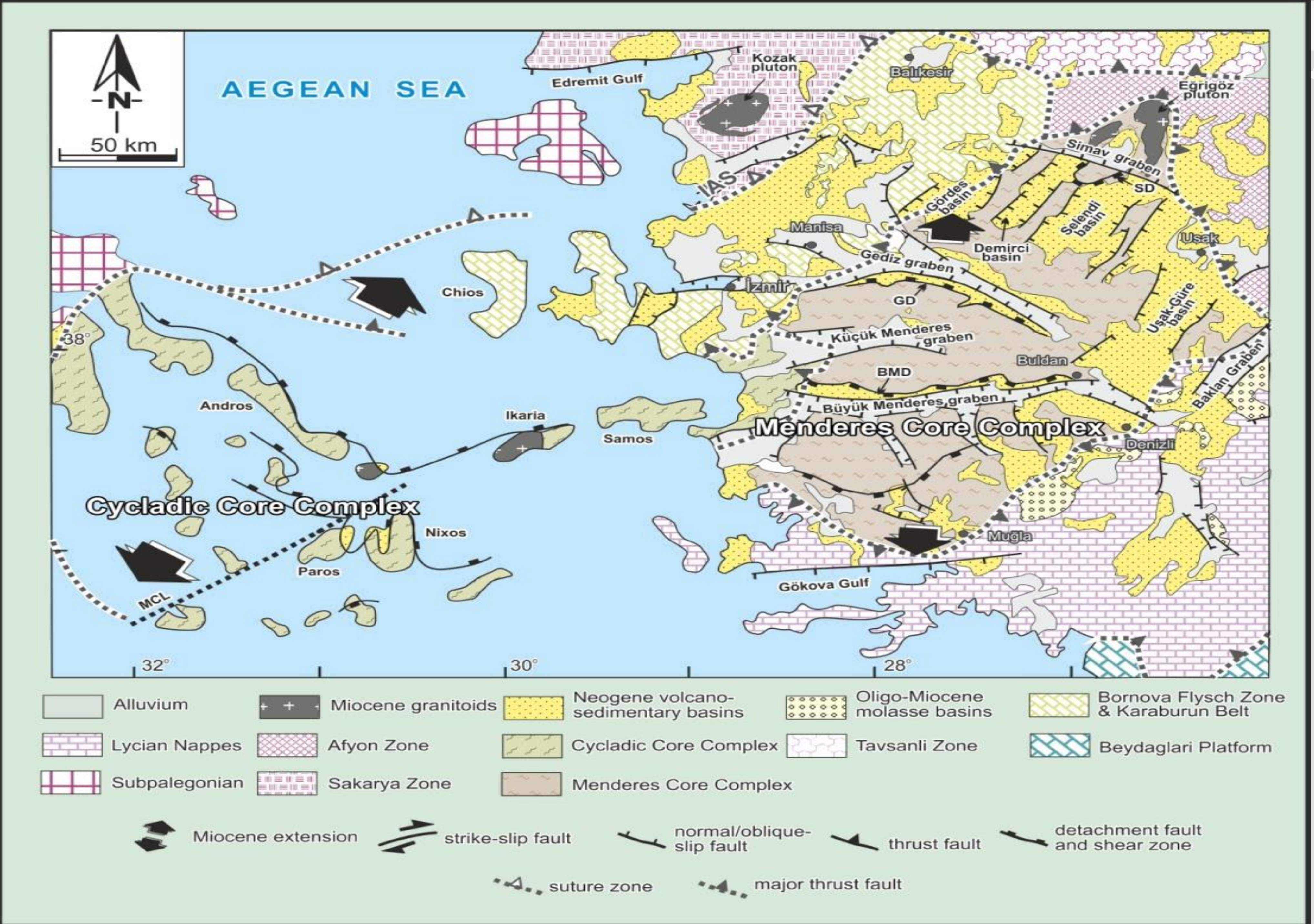


Figure 3. Main geological structure of Western Anatolia

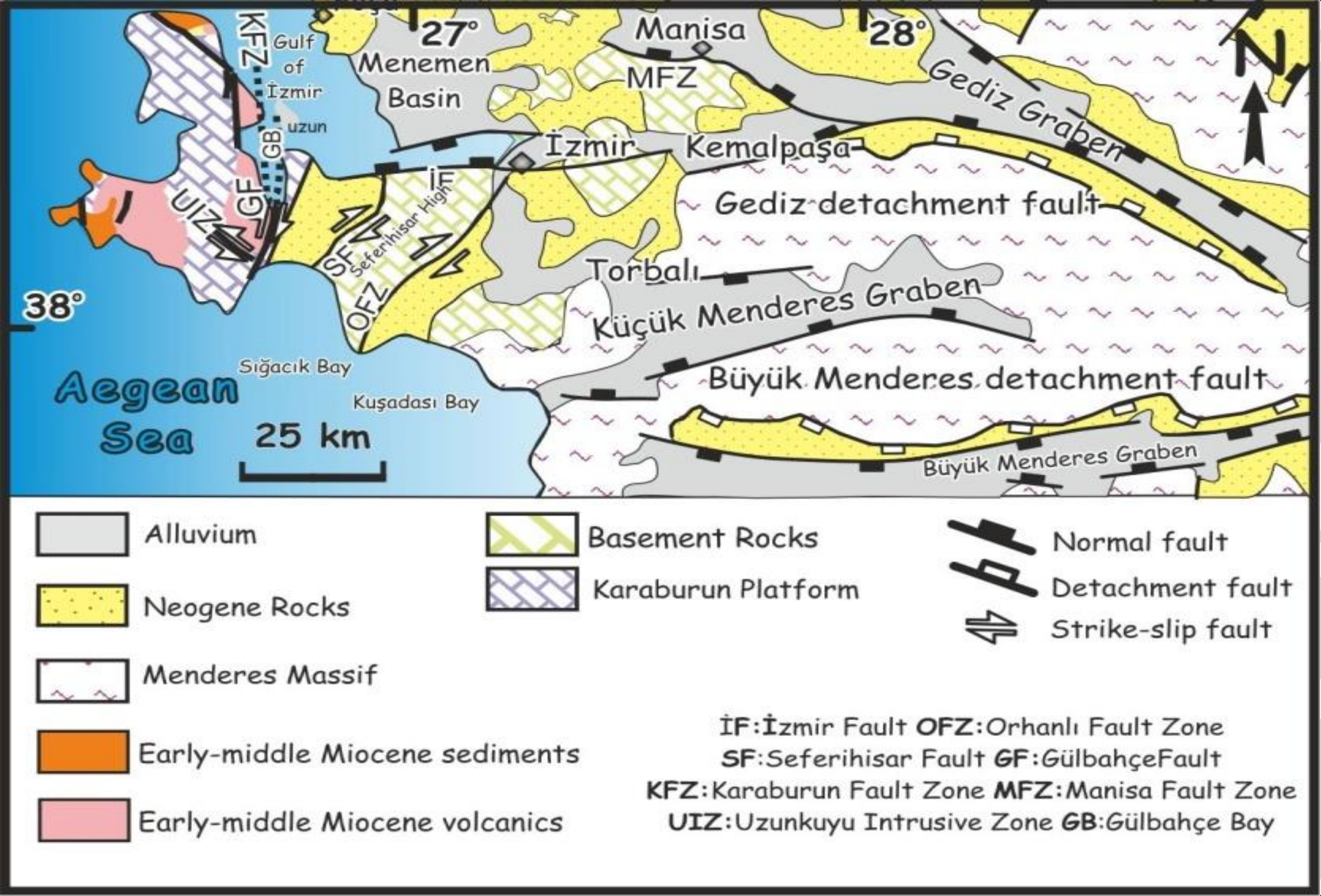


Figure 4. Main geological structure of İzmir and its surroundings

In İzmir and its surrounding, the NE-SW directional dextral strike-slip faults are dominant and the most important faults are Seferihisar, Orhanlı and Gülbahçe fault zones.

The E-W trending graben system is the main tectonic structure of Western Anatolia.

Additionally; NE-SW trending basins which are located at NE side of E-W trending graben system are also effective at the complex tectonism of Western Anatolia.

Gülbahçe fault zone is the east border of the N-S trending of Karaburun Peninsula.

Karaburun fault zone dominates the southwestern of İzmir Bay.

PERFORMING AND PROCESSING GPS OBSERVATIONS

In the study of **Nyst and Thatcher (2004) (Fig. 5),** based on the GPS observations, some dissimilarity (red circle in Fig. 5) in the GPS velocity vectors was found out between Western Anatolia and İzmir city.

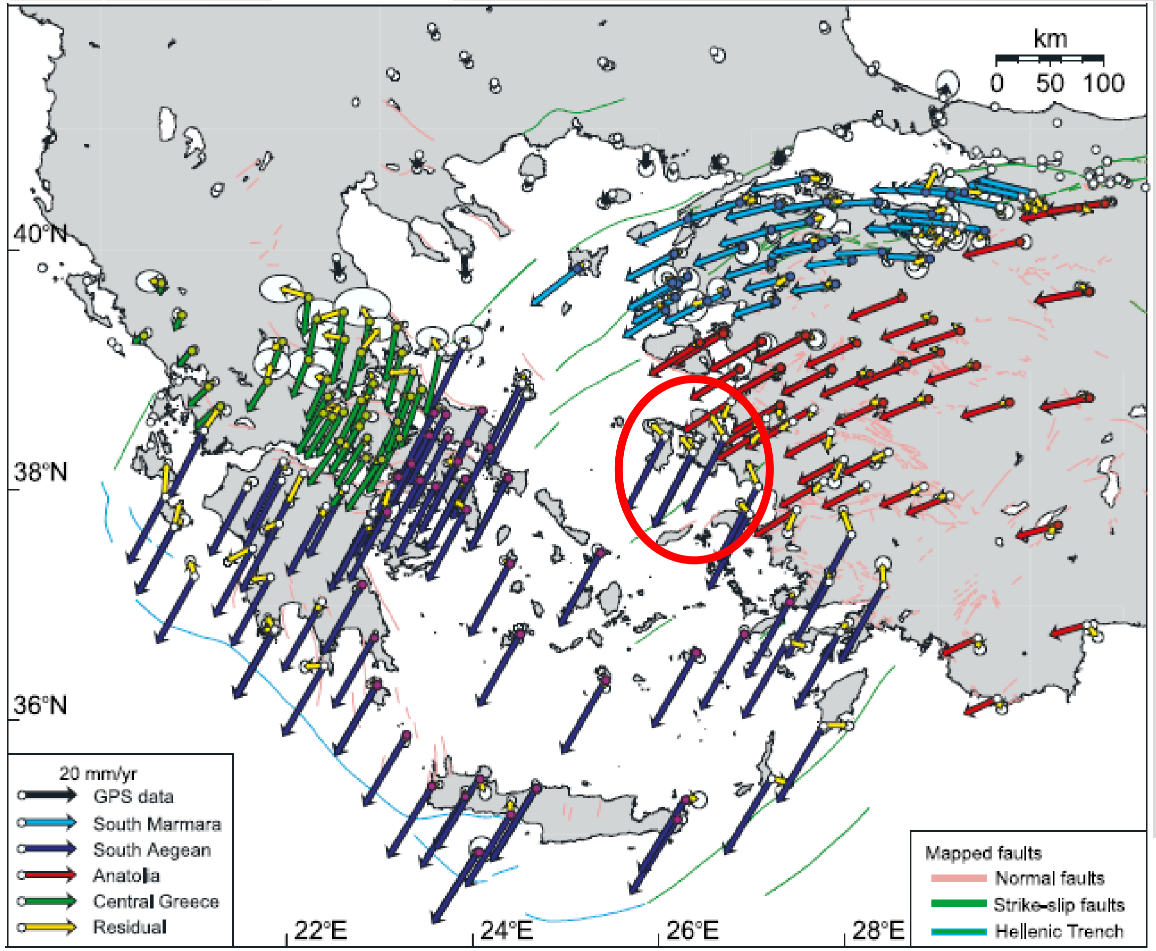


Figure 5. The study of Nyst and Thatcher (2004) shows that GPS velocity vector directions have some differences surrounding Izmir.

Additionally, **Gessner et al. (2013) (Figure 6)** mentioned the existence of a N-S directional transfer zone, namely; Western Anatolia Transfer Zone (approximately at 27.5-28° longitude) by using the earthquake focal depths.

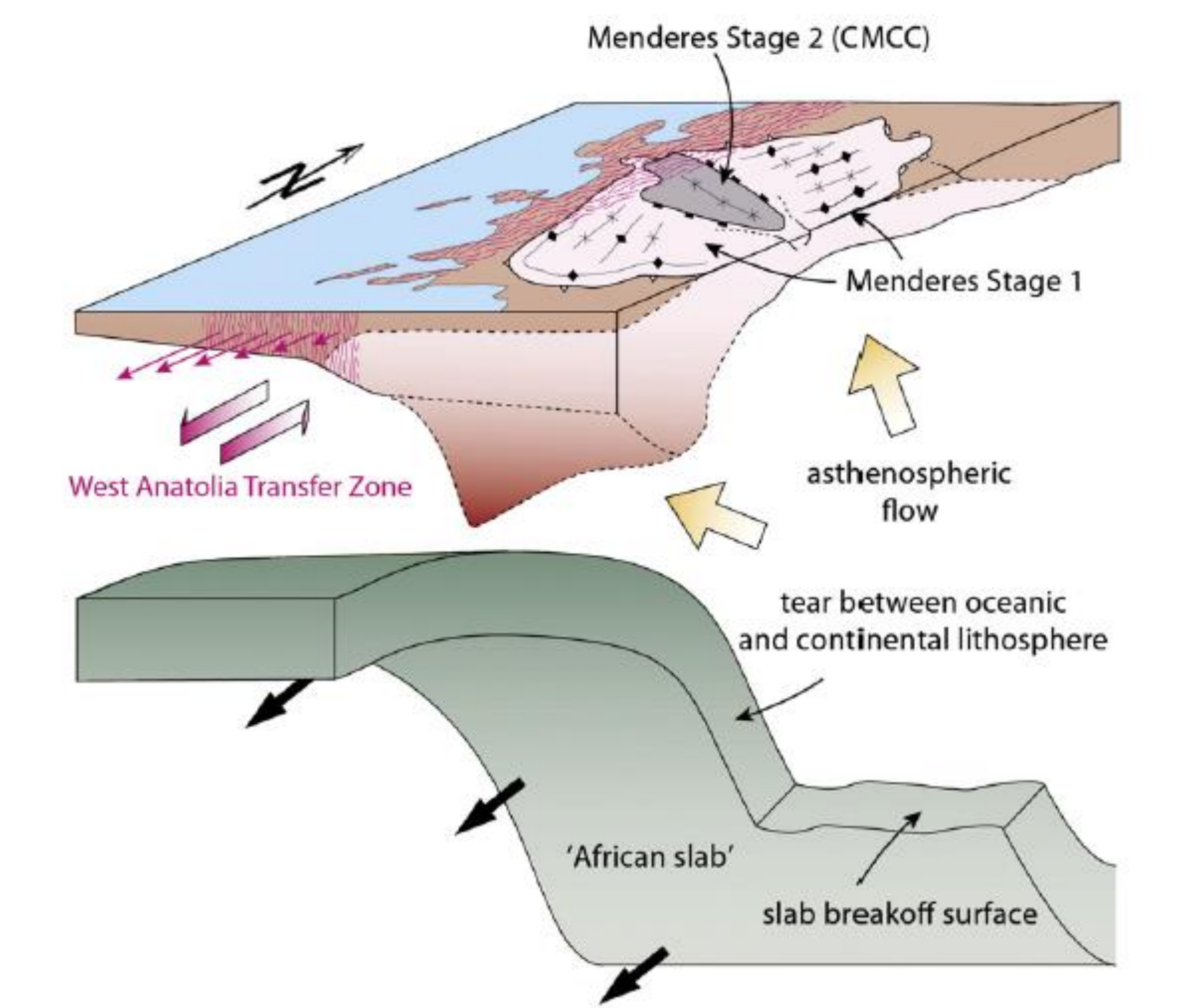


Figure 6. Gessner et al., 2013.

For analyzing the difference between the kinematic motions of İzmir and Western Anatolia, GPS observations performed in İzmir and Western Anatolia were processed together.

Three GPS campaigns were conducted in 2009, 2010 and 2011 at 21 stations in the south of İzmir (Figure 7).

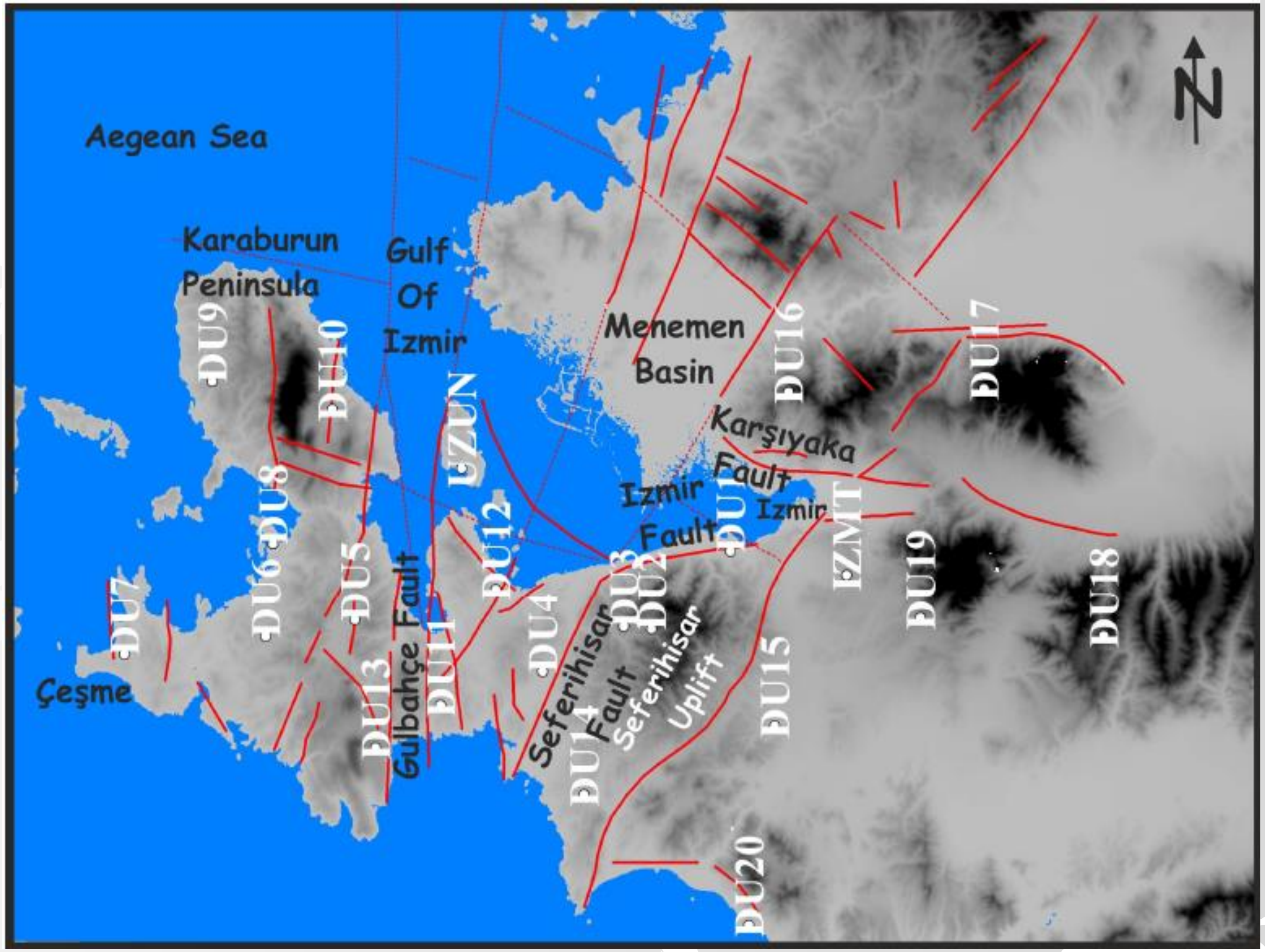


Figure 7.

In 2009:

GPS observations were performed for 3 days in two groups (DoY: 183-185 and 186-188). In each group, 10 stations were observed per session for 10 hours.

The station “**UZUN**” was observed for 4 days.

In 2010:

Observations were performed in three groups (DoY: 184-186, 187-189 and 190-192) with 3 sessions for 10 hours.

Besides, UZUN and DU12 stations were observed for nine days.

In 2011:

21 stations were observed for 10 hours for 3 sessions in 3 groups (DOY: 183-185, 186-188 and 189-192). During this campaign DU05, DU12 and UZUN stations were observed continuously.

In addition to the 3 GPS campaigns;

- GPS observations of two national GPS projects namely;
    a. CORS-TR
    b. TURDEP (Multi-Disciplinary Earthquake Researches in High Risk Regions of Turkey Representing Different Tectonic Regimes)

were processed using GAMIT/GLOBK.

For connecting the local network with the ITRF network IGS stations were also included to the processings.

12 IGS stations; ISTA, TUBI, ANKR, ZECK, NSSP, NICO, MIKL, GLSV, BUCU, PENC, WTZR and MATE were used to define the Eurasia-fixed reference frame.

GPS processing strategy

Data Interval	30 sec.
Cut Off Elevation	10 degree
Day Of Year	183-192
Orbit	IGS final orbit and ERP
Antenna Phase Center Variation	Elevation dependent weighting model (PCV-antmod.dat)
Troposphere Parameters	VMF (Vienna Mapping Function) model. Zenith parameters were estimated for every 2 hours.
Correlation	Full correlation between observations and unknowns.
Final Coordinate Estimation	Daily solutions were combined using GLOBK

ITRF2008 coordinates of these IGS stations were used as reference in the computations.

The repeatabilities are under 5 mm on horizontal (north and east) component and under 10 mm on the vertical component (Figure 8).

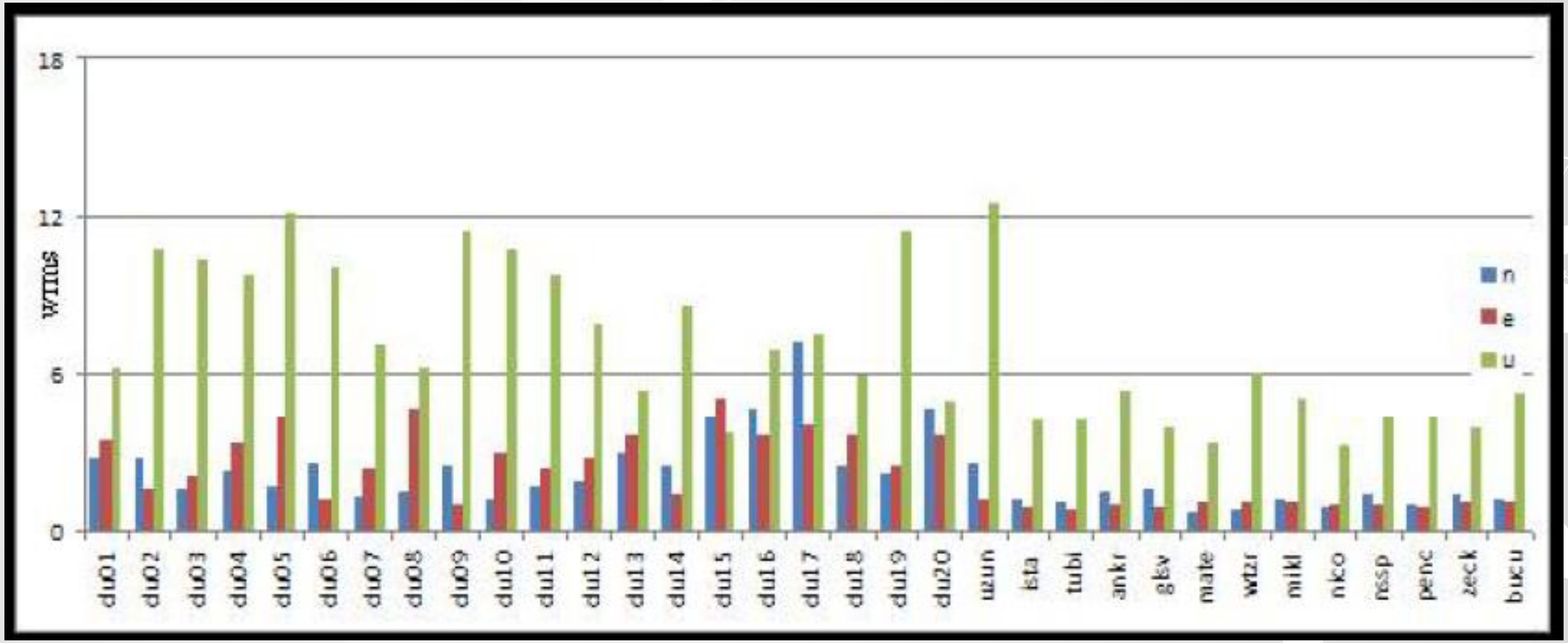


Figure 8. WRMS (mm): combination of 2009, 2010 and 2011

In this study for investigating the interplate motions of the region, the Anatolian block fixed frame solutions (**realized by using the Euler vectors relative to Eurasia for Anatolian block**) were computed.

In (Reilinger et al., 2006), the Euler vectors were given as 30.8°N, 32.1°E and 1.231°/Myr for Anatolian block fixed solutions.

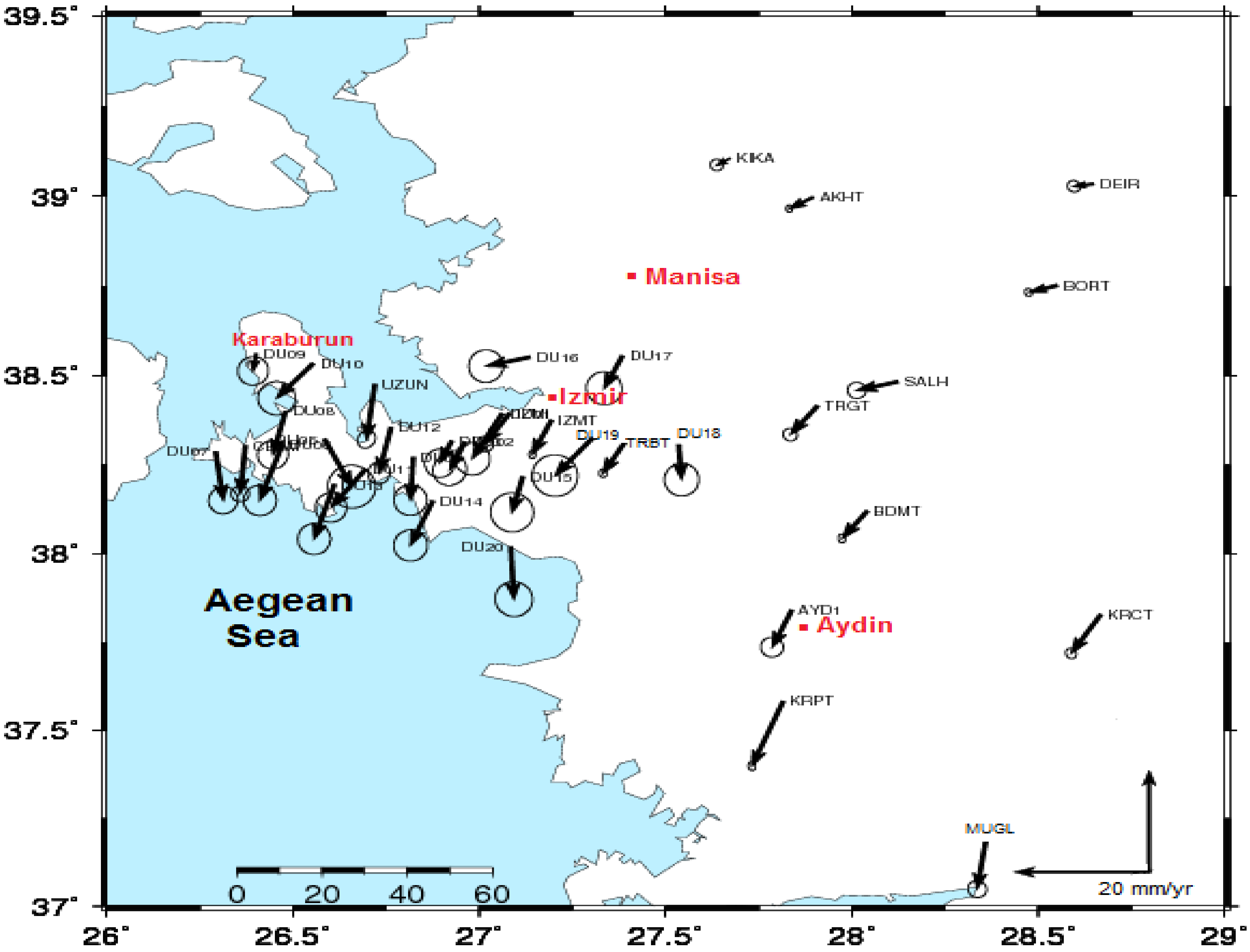
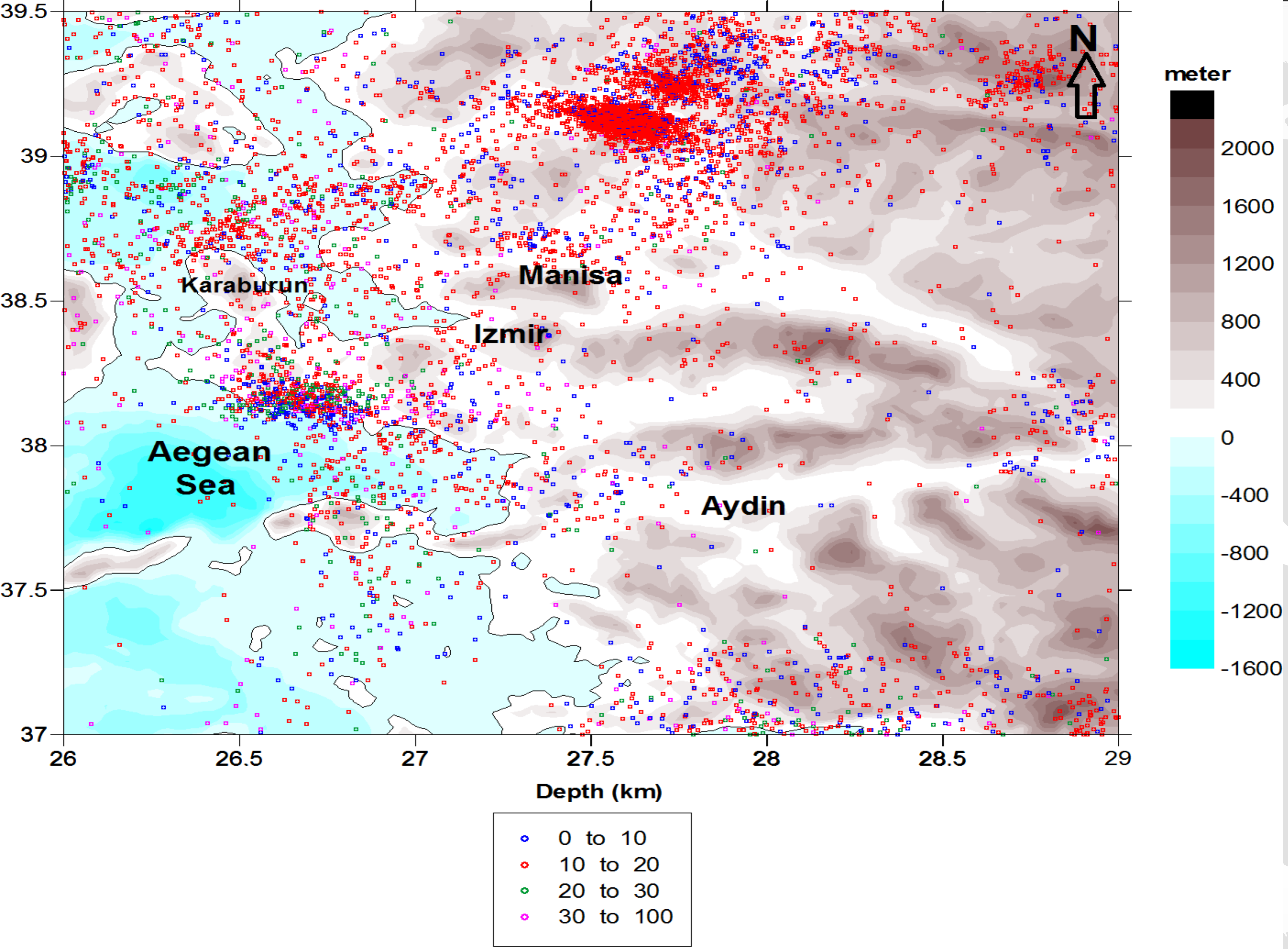


Figure 9. The velocity field with **95% confidence ellipses** of the stations computed in Anatolian block fixed frame from 3-years (2009, 2010 and 2011) GPS observations by using Euler vectors obtained relative to Eurasia.

Additionally, for interpreting the dissimilarities on the GPS velocities of the micro-plates, the earthquakes occurred between the years 1973 and 2016, with an amplitude range between 2.5 and 9.0 were taken from United States Geological Service (USGS) and the focal depth distribution map was obtained. (Figure 10)



SELÇUK ÜNİVERSİTESİ

Figure 10. Topographic map of study area and the earthquake focal depth distributions between the years 1973-2016 (from USGS). (The topographic data was obtained from TOPEX; Smith and Sandwell, 1997.)

DISCUSSION

Due to the dissimilarities on the GPS velocity directions we found in the Anatolian block fixed frame solution, the study area was divided into 3 zones (as zones A, B and C) by taking into account these directional dissimilarities (Figure 11)

ZONE A: Anatolian block

ZONE B: Aegean block

ZONE C:Southwest Anatolian block

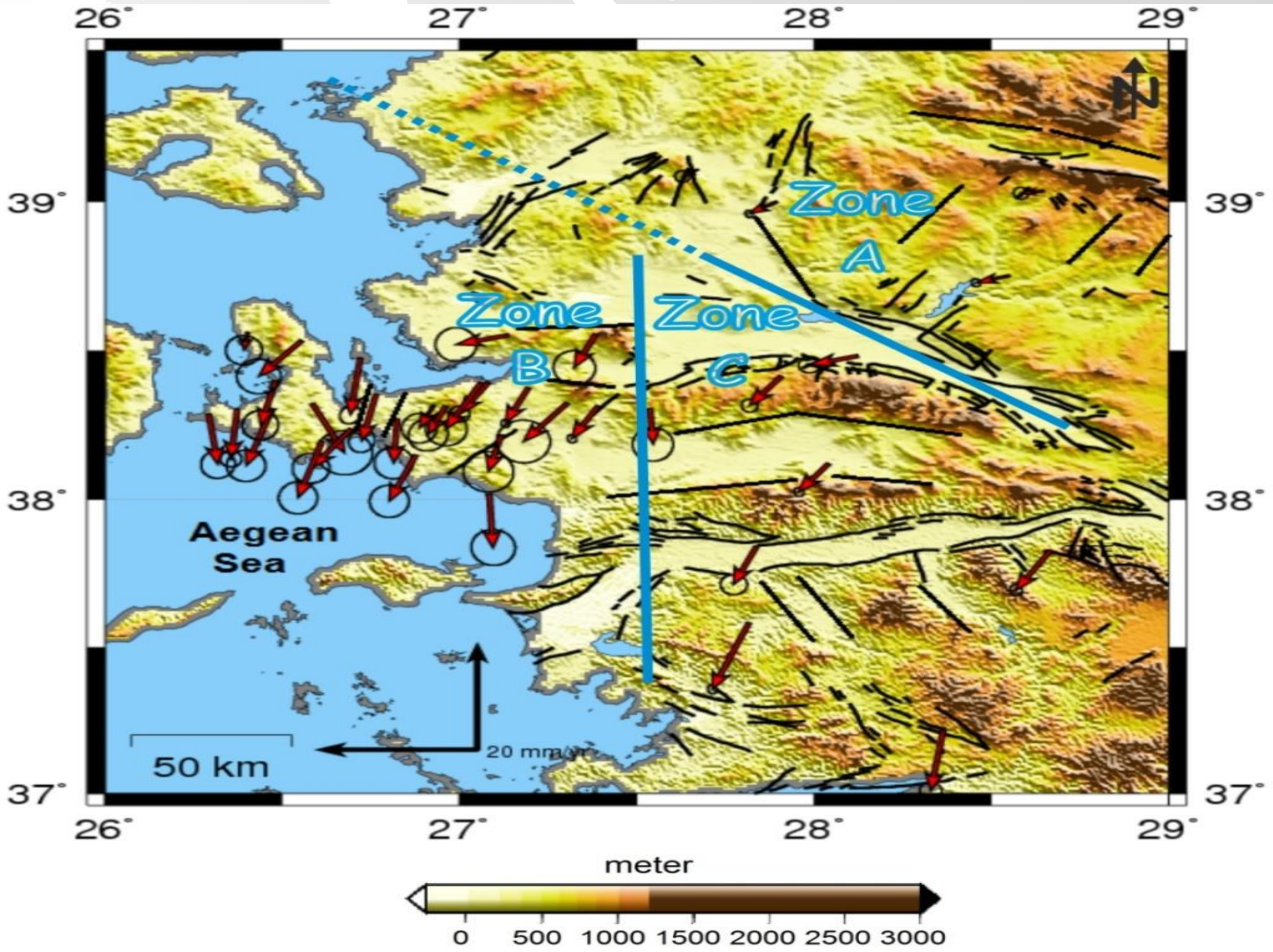


Figure 11. Directional dissimilarities of GPS velocities

In zone A the directions of GPS velocities are approximately towards W and the velocity amplitudes are lower than the other GPS velocities at Zones B and C (Figure 11).

It is thought that these GPS stations located at zone A are under the effect of NE-SW trending basins (which is shown with red square in Figure 3).

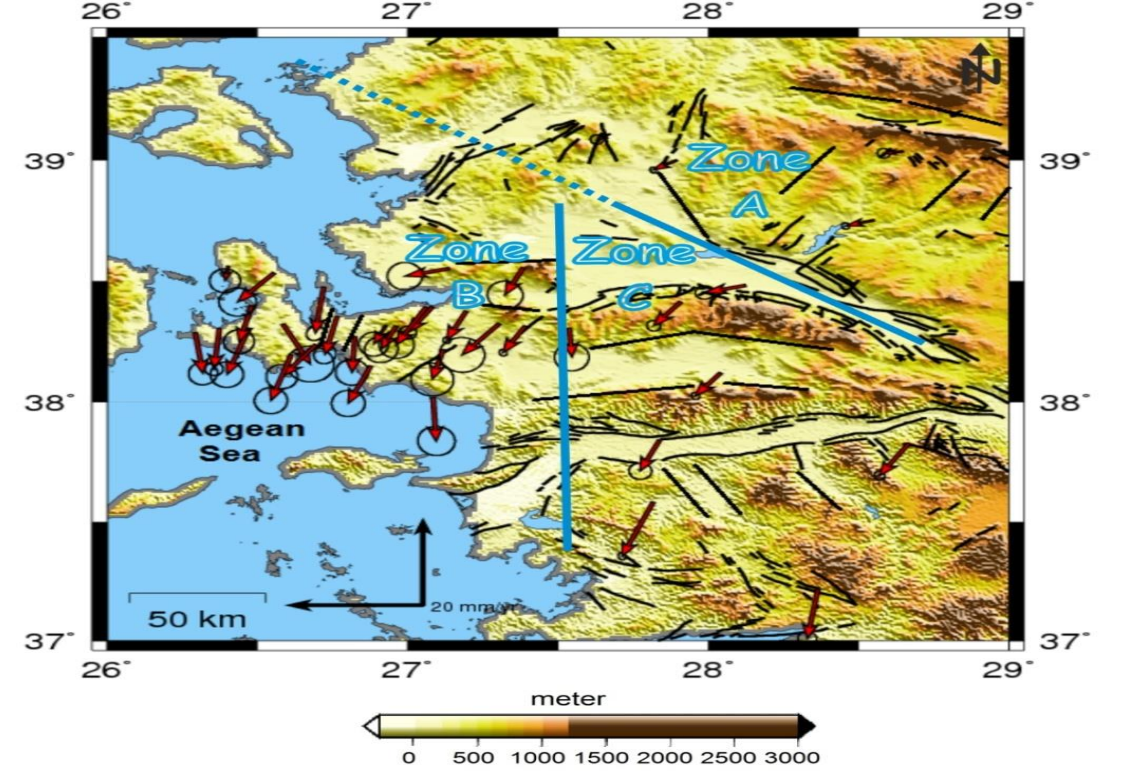


Figure 11

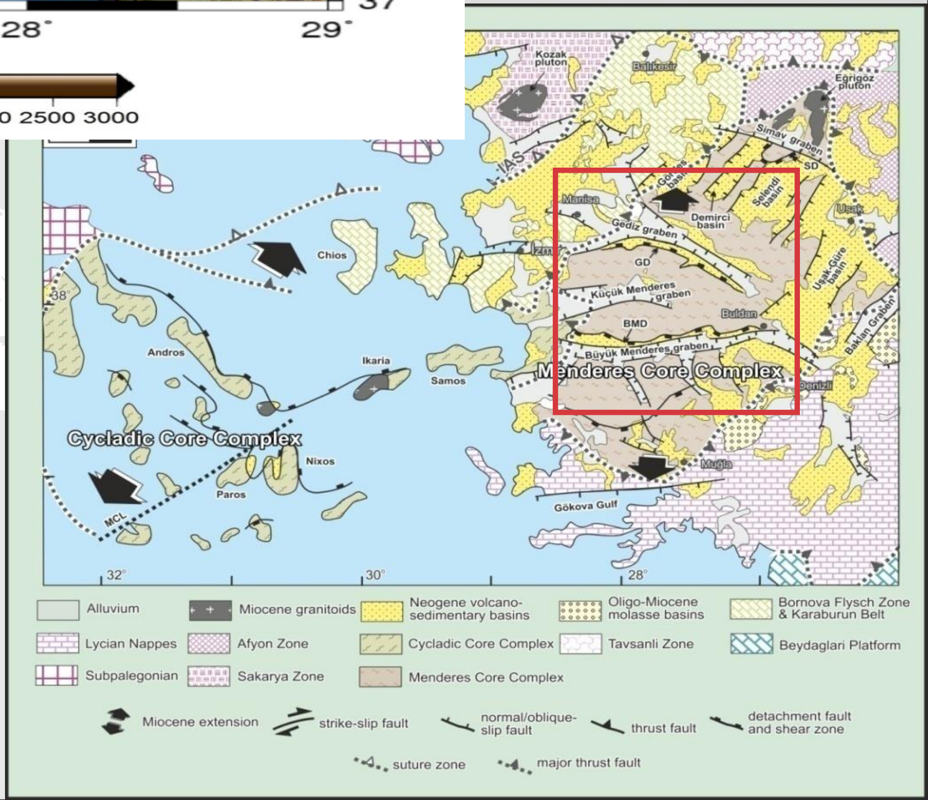


Figure 3.

In Figure 11, it is seen that the directions of GPS velocities at zone B are generally towards S.

On the other hand, the directions of GPS velocities at zone C are generally towards SW (Figure 11).

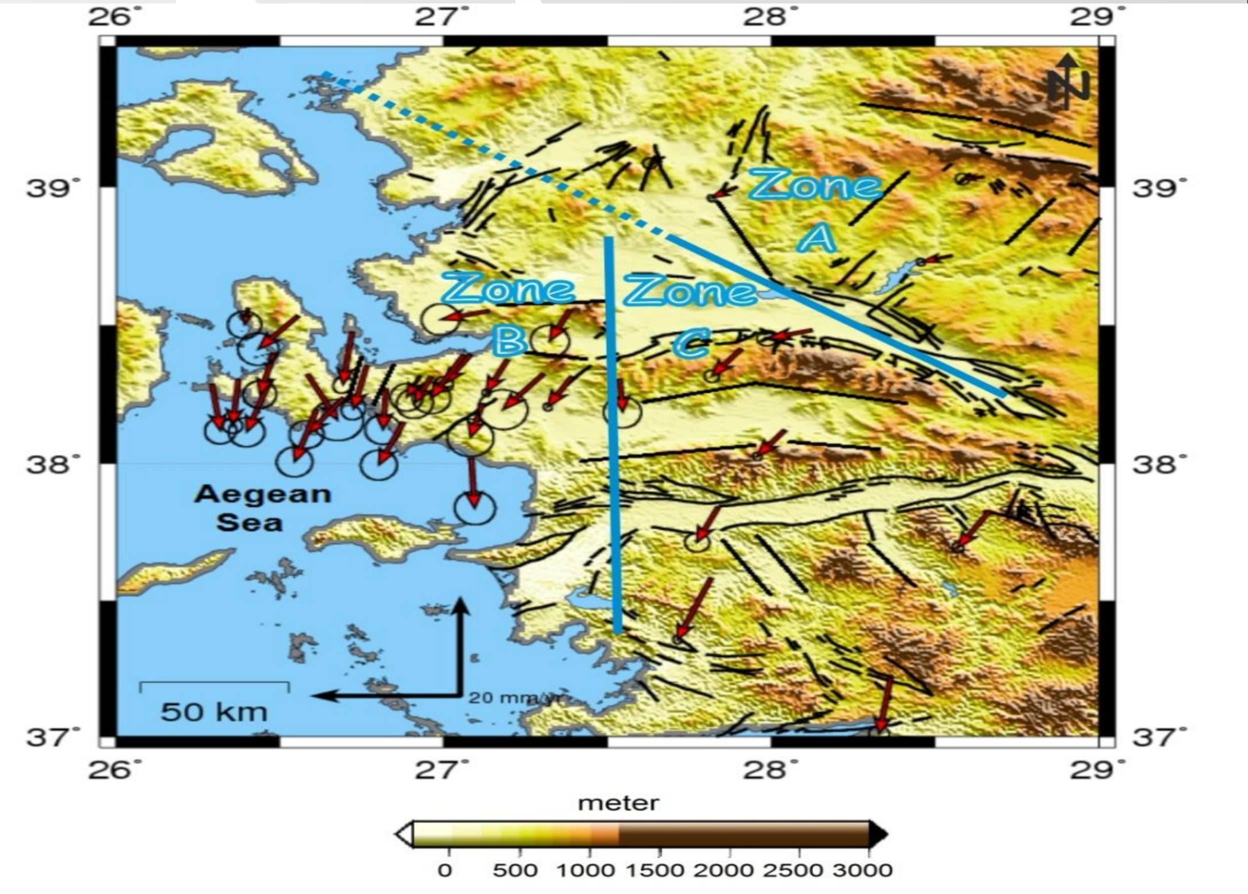
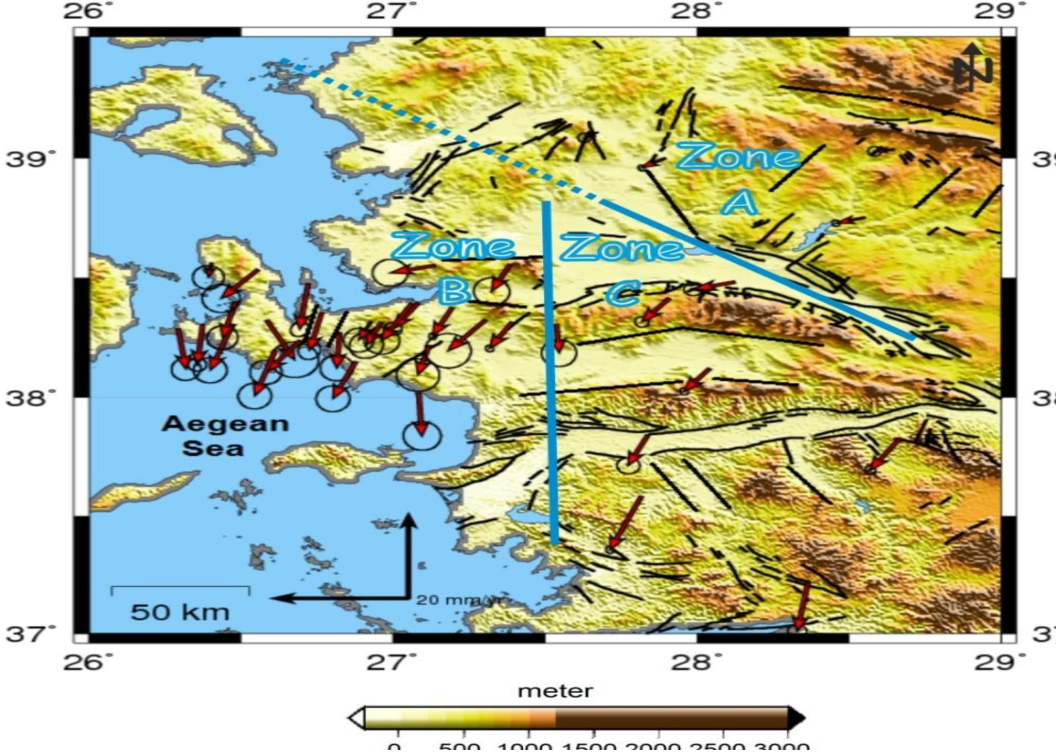


Figure 11

It is thought that the orientations for the GPS velocities at zone B (Karaburun and its surroundings) occur with the effect of the roll-back process at Eastern Mediterranean Sea through Hellenic Subduction zone (Aegean Arc)(Figure 2).



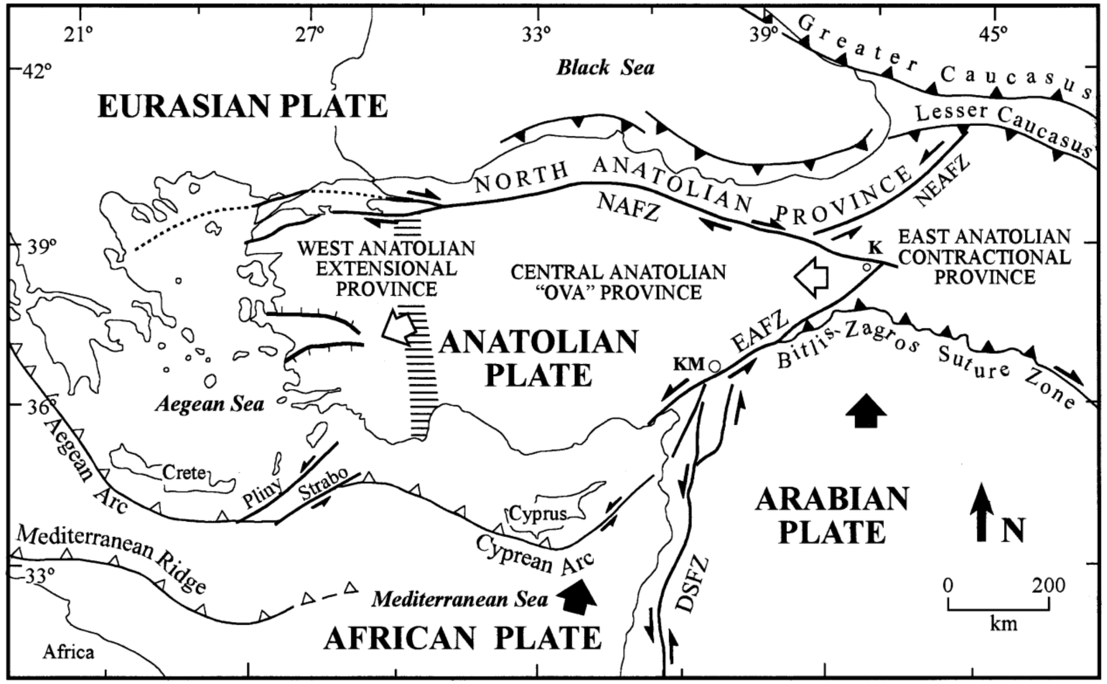
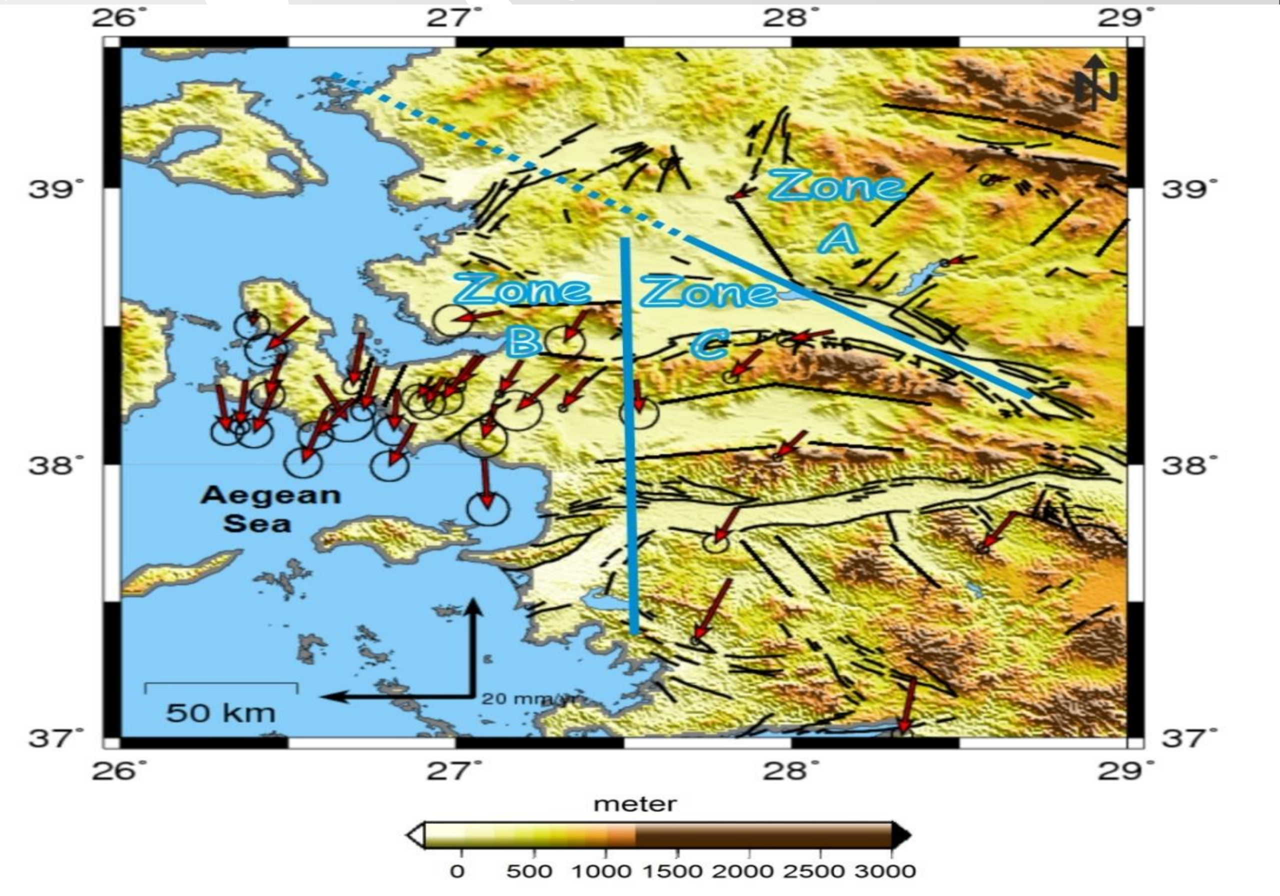


Figure 2

Additionally, a stable block at western of Karaburun Peninsula stops these movements and change the directions of the GPS velocities.

It was also found that the GPS velocities at zone C are bigger than the GPS velocities at zone B.



The reason of the differences on the velocity magnitudes for these zones may be the effect of existence of greater dipping angle at eastern wing of Hellenic Subduction zone relative to western wing (Papazachos et al., 1995).

Consequently, if these results are compared with the earthquakes occurred at the study area between the years 1973-2016 (Figure 10), it is noticed that the distributions of earthquakes represent coherency with the groups at Figure 11 created by directional dissimilarities of GPS velocities (Figure 12).

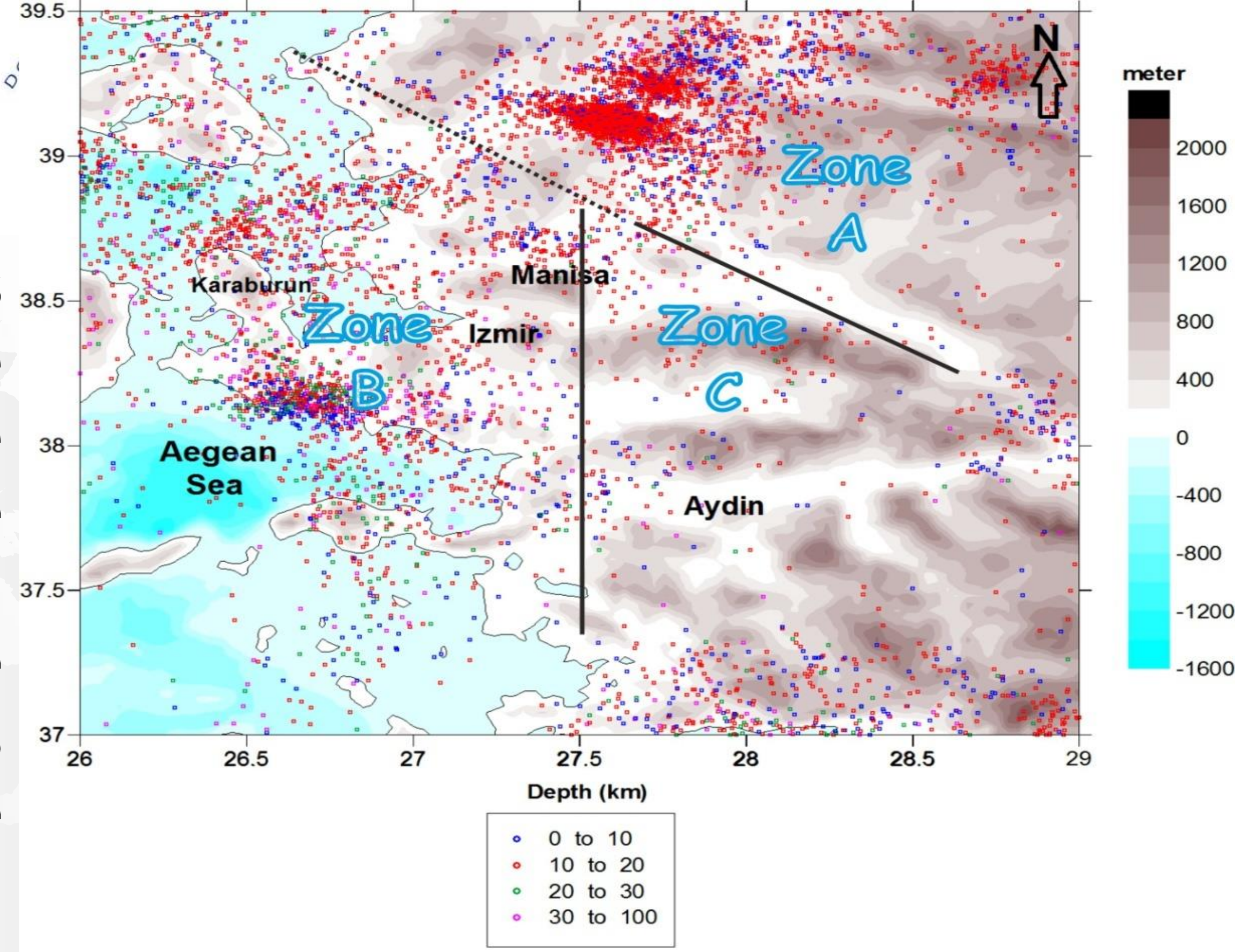


Figure 12. Distributions of earthquakes and the zones occurred with the differences on GPS velocities

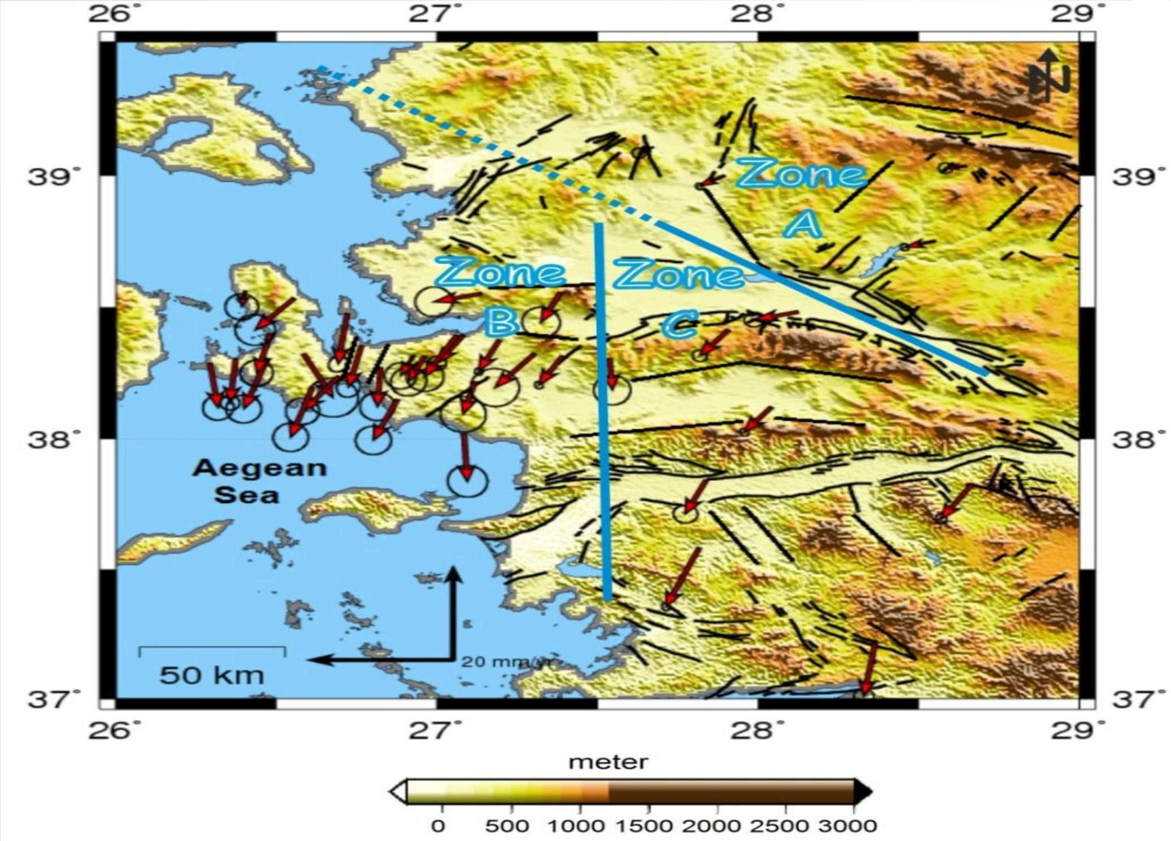
CONCLUSIONS

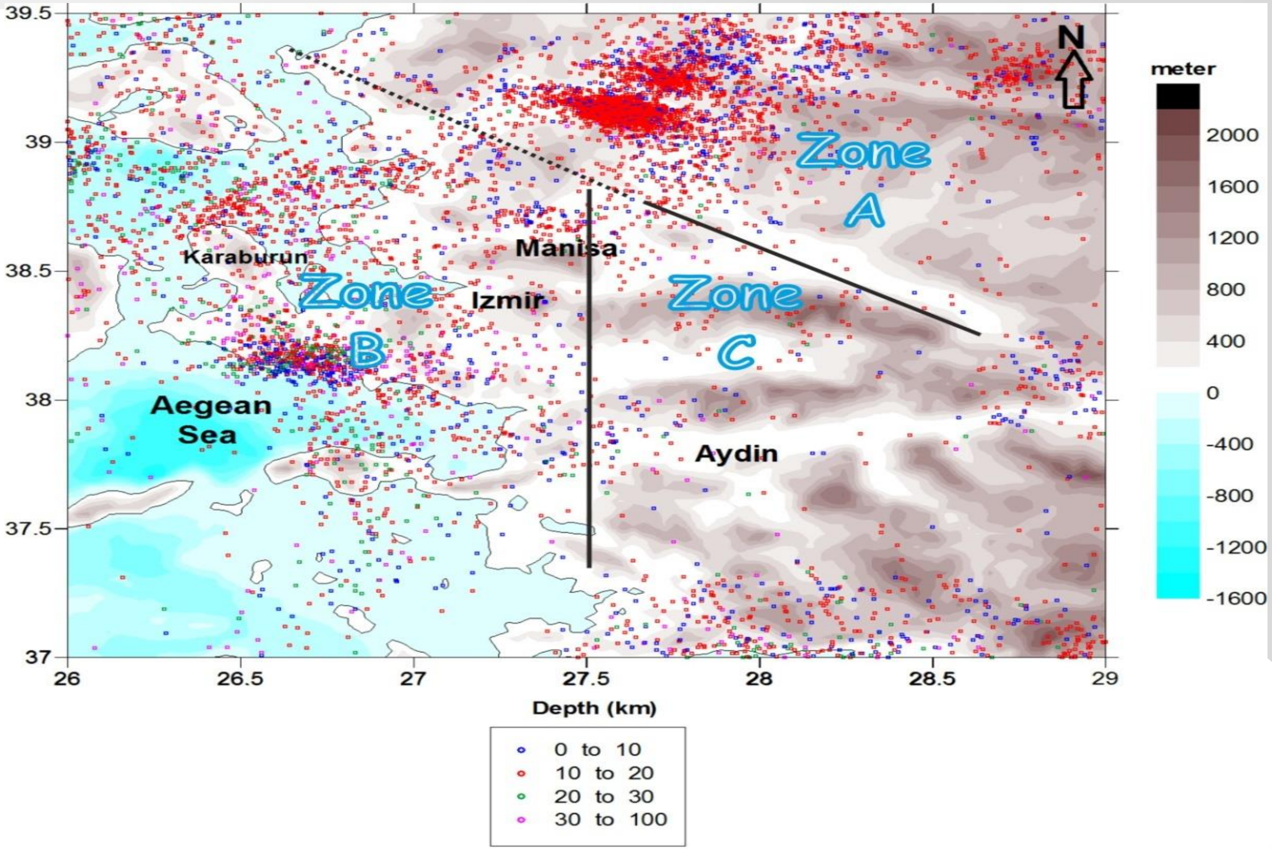
Our findings were evaluated with the earthquakes occurred in the study area since 1973.

It was found that the seismicity was higher on the Karaburun belt and its surrounding relative to the eastern side where the E-W trending tectonic elements located.

The border which separates the seismicity differences is coherent with the velocity direction changing border of GPS vectors.

Additionally, the orientation of the seismic activity and the trending of the tectonic structures at eastern part of Karaburun are figured out to be coherent with the GPS velocity directions.





THANK YOU FOR YOUR ATTENTION!

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