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Does Continuous Compressive Tectonic Regime Exist During Late Palaeogene to Late Neogene in NW Central Anatolia, Turkey? Preliminary Observations

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Abstract: The suggested continuous Late Palaeogene to Late Neogene compressional regime in NW central Anatolia has been re-investigated by the field observations on the previously reported key locations around Yuva, Yakacık and Edige villages. Our observations conclude that in all locations, especially around Yuva village, the relationship between the basement and Neogene units does not satisfactorily show a compressional regime and therefore the claim of the continuous compressive tectonic regime in the NW central Anatolia is questionable.

Orta Anadolu'da Geç Paleojen - Geç Neojen Döneminde Sürekli Sıkışmalı Bir Tektonik Rejim var mıydı? İlk Gözlemler

Özet: Geç Paleojen - geç Neojen aralığında devam ettiği belirtilen KB İç Anadolu'daki sıkışmalı rejimin varlığı, daha önce rapor edilen Yuva, Yakacık ve Edige köyleri civarındaki anahtar lokasyonlarda arazi çalışmaları ile tekrar incelenmiştir. Arazi gözlemlerimiz, bütün lokasyonlarda, özellikle Yuvaköy civarında, temel ve Neojen kayaçları arasındaki ilişkinin bir sıkışmalı rejimi temsil etmediğini ve bu nedenle devamlı olduğu önerilen sıkışmalı rejimin varlığının şüpheli olduğunu göstermektedir.

Introduction

The basement in NW central Anatolia is composed of three units, namely Sakarya continent, İzmir - Ankara suture zone and Kırşehir block (Görür et al., 1984). The Late Cretaceous to Early - Middle Palaeogene rock units are interpreted as a product of accretionary fore-arc basin (Gökten et al., 1988; Koçyiğit, 1991a).

There are different views regarding the tectonic framework of NW central Anatolia (Figure 1) from Late Palaeogene to Late Neogene. Gökten et al. (1988) proposed a compressive tectonic regime during Oligo-Miocene that changed into an extensional regime in Pliocene. However, Koçyiğit (1991b) suggested pre-Late Miocene NW-SE and post-Late Miocene N-S compressional regime in NW central Anatolia. His statement is based mainly on four different key locations around Ankara. These are 1 km W of Yuva, 400 m NE of Yakacık, 500 m SE and 2 km N of Edige villages (Figure 1). On these locations Koçyiğit (1991b) shows that the older basement rocks thrust onto Late Miocene - Pliocene (?) Yuva group and Late Pliocene Yalıncak formation which are given as field evidence of continued, even if it changes the direction, compressional regime until the end of Late Pliocene.

This paper presents the results of new observations from the mentioned key locations and puts forward a hypothesis to be tested for Late Cenozoic NW central Anatolian tectonic history.

Field observations on the key locations

There is an age problem regarding the late Cenozoic stratigraphy (Seyitoğlu & Büyükönal, 1995) therefore previous workers' age determinations are accepted until the problem is solved.

Around Yuva village: In the 1 km W of Yuva village at Çakmaklı Tepe (Figure 2a), the relationship between ophiolitic basement and Neogene unit is a nor-

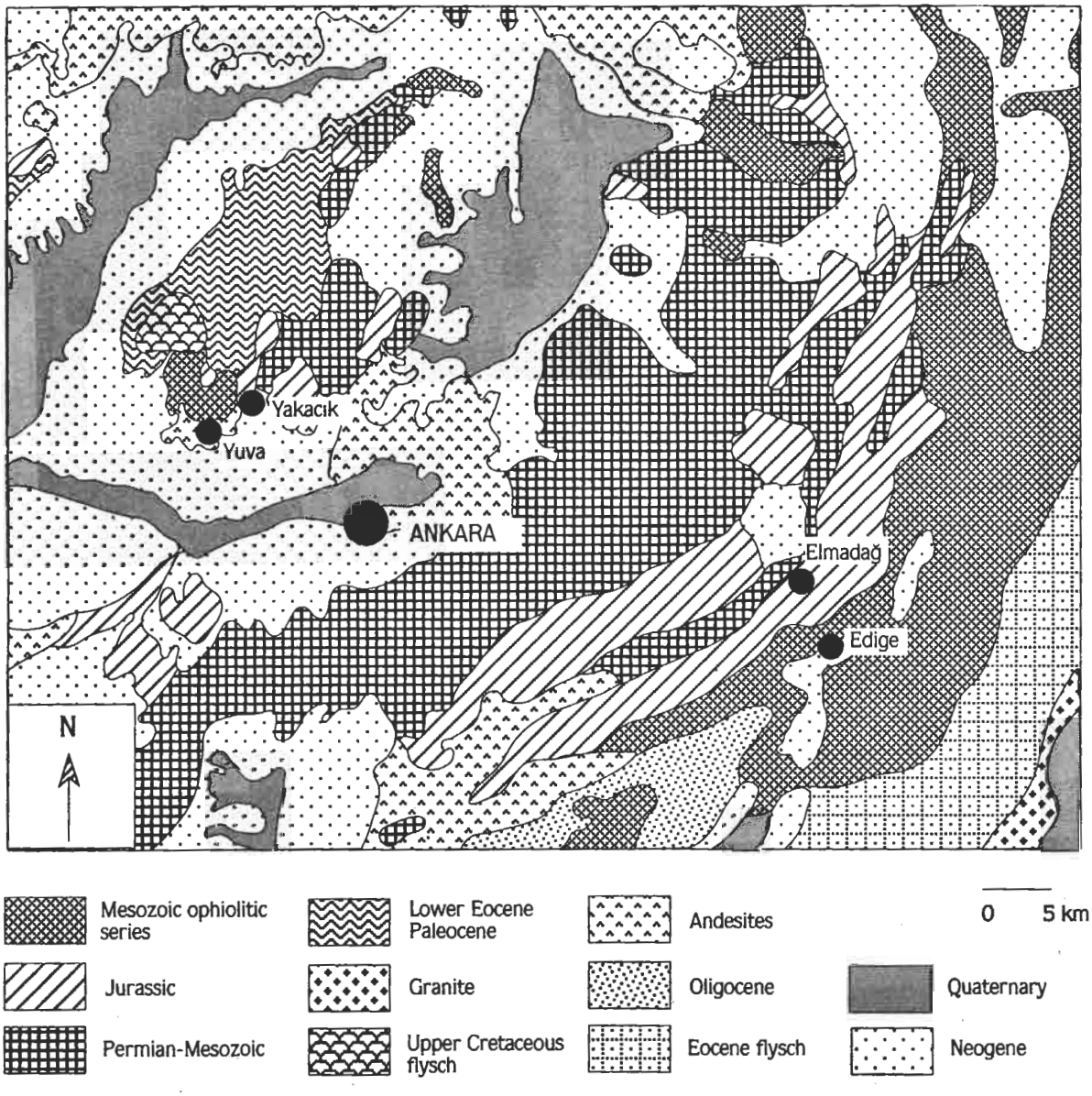


Figure 1. Geological map of Ankara.
(Simplifed from Geological Map of Turkey. 1977)

mal fault dipping towards south - southwest. Its trace on topography is apperent in the valley immediately east of Çakmaklı Tepe (Figure 2a). Examination of the Neogene unit from the road to the top of Çakmaklı Tepe demonstrate that lacustrine white marl - limestone alternation passes upwards the brown lithology which is a kind of siliceous travertine and/or travertine like chert.

Further to north, larger ophiolitic outcrop can be seen around Sarıkaya and Yumrukaya (Figure 2b). Its contact with the Neogene unit is a E-W trending normal fault dipping south. Its trace on topography is clearly followed in the N-S trending valleys. In some places, such as Bozyerler Sırtı, Neogene unit shows a faulted - overlapped contact with the ophiolitic basement (Figure2b).

NE of Yakacık village: The Neogene semi and / or unlithified cobble - gravel conglomerates with andesite cobbles and volcaniclastics unconformably cover the Mesozoic basement. Neogene sediments are limited by

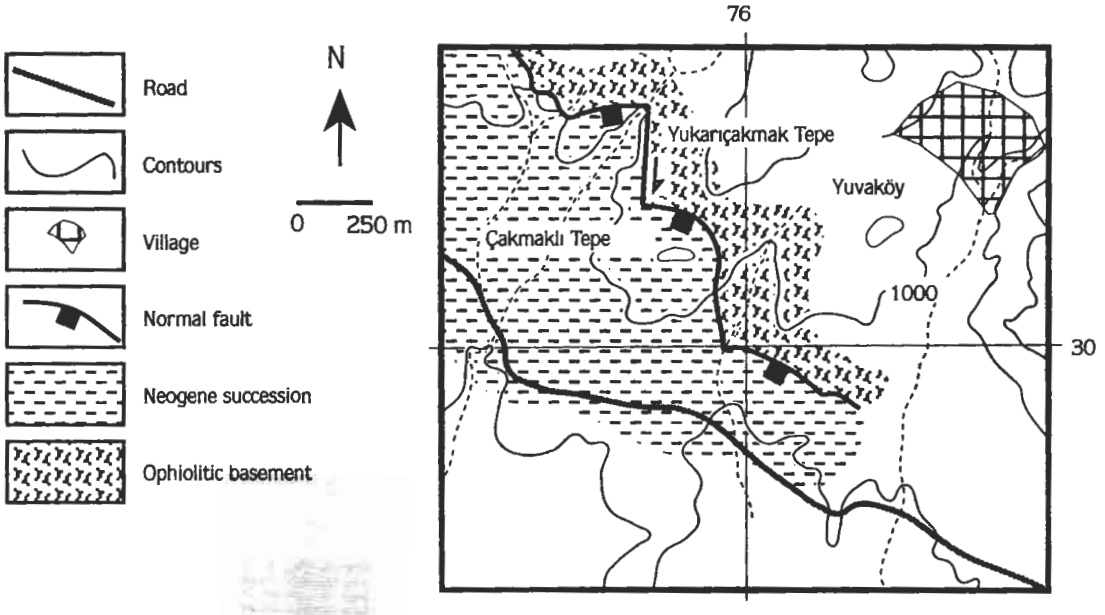


Figure 2a. The relationship between Ophiolitic basement and Neogene sedimentary rocks in 1 km west of Yuva village. Please note that Yukarıçakmak Tepe and Çakmaklı Tepe contain brown lithology but careful examination shows that the brown lithology in Çakmaklı tepe belongs to Neogene susscession (see text).

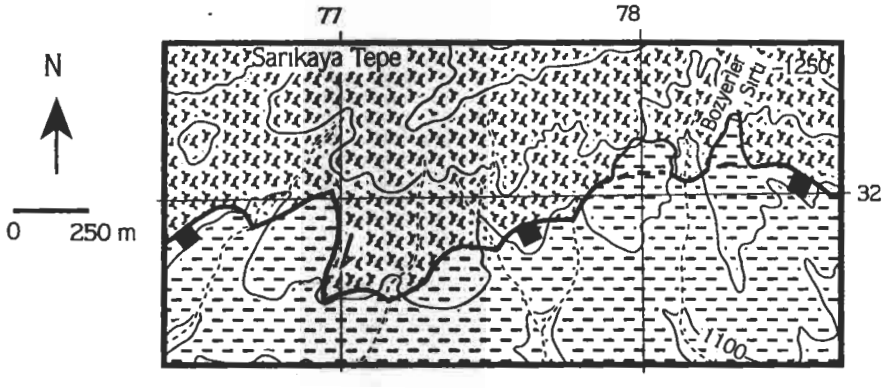


Figure 2b. The relationship between Ophiolitic basement and Neogene sedimentary rocks in the north of Yuva village, around Sarıkaya. Symbols are same with Figure 2b.

normal faults trending NW - SE at NE of Yakacık and SW slope of Domuzdamı Tepe. Additionally, a NE - SW trending faults can be seen between Neogene units and the basement at the south of Domuzdamı Tepe (Figure 3).

Edige village: In the SE of Edige, Neogene sediments are in a half graben structure and NNE trending normal fault limits the eastern margin of the basin. Neogene successions, which are mainly red clastics, unconformably overlie the Oligocene (Akyürek et al., 1984) clastic unit and the ophiolitic basement in the N and NW part of the basin (Figure 4 and 5). According to the map of Akyürek et al. (1984) and our observations around Edige demonstrate that the ophiolitic basement thrusts onto Oligocene (Akyürek et al., 1984) clastic unit.

Discussion and Conclusions

Koçyiğit (1991b) presented four different key locations where Mesozoic basement rocks are believed to be thrusted onto late Miocene to late Pliocene sedimentary units. One of these locations, around Yuva village, is investigated in detail by Koçyiğit (1992) which proposed similar views with Koçyiğit (1991b) that the compressional regime due to the collisional tectonics

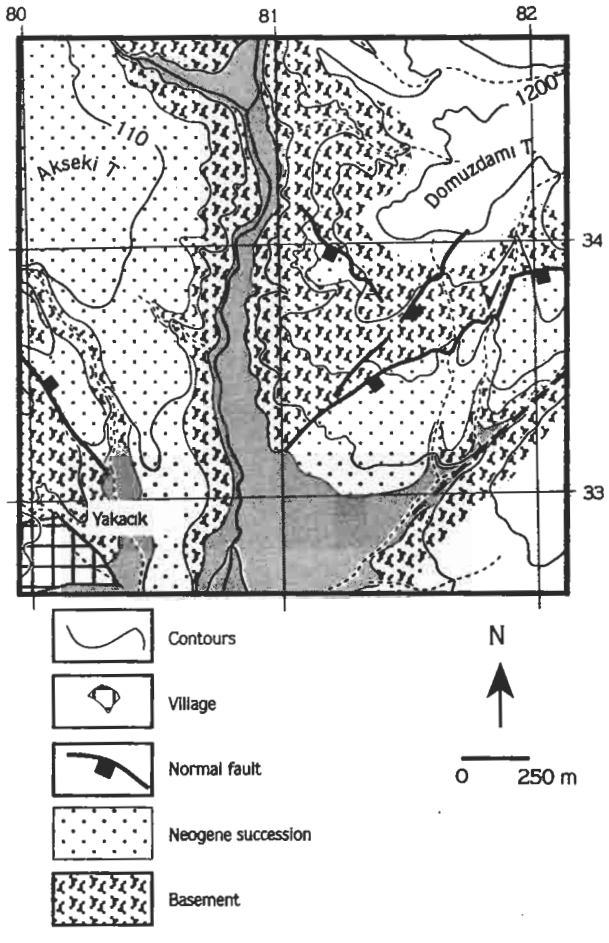


Figure 3. The relationship between pre-Neogene basement and Neogene succession in NE of Yakacık.

continued until Pontian (Late Miocene). Following Miocene, it is suggested (Koçyiğit 1992) that compressional events related to strike slip faults persisted in the NW central Anatolia (Figure 6a). The field evidences for continuous compressional regime during Neogene (Koçyiğit, 1991b) will be discussed under the light of above observations.

Around Yuva village: It is reported (Koçyiğit, 1991b; Figure 6a and Koçyiğit, 1992; Figure 2) that an ophiolitic basement thrust onto Late Miocene - Pliocene Yuva group in the 1 km W of Yuva village at Çakmaklı Tepe. On the other hand, our observations (see earlier) demonstrate that there is no such thrust in this location. The reason of the Koçyiğit (1991b)' s interpretation is probably due to the mixing of the brown lithology of the Neogene at Çakmaklı Tepe and that of ophiolitic basement at Yukarı çakmak Tepe (Figure 2a). The brown lithology at Çakmaklı Tepe is a kind of siliceous travertine and/or travertine like chert and comes onto the lacustrine marl - limestone alternation and belongs to the Neogene succession. There is no shear zone or any indication of faulting between Neogene lacustrine sediments and the brown lithology which is located on top of Çakmaklı Tepe.

Further to north on the S of Sarıkaya Tepe and Yumrukaya Tepe, Koçyiğit (1992, Figure 2) claimed that the ophiolitic basement thrust onto Neogene unit. However, our observations clearly demonstrate that a normal fault exists between the ophiolitic basement and Neogene unit which overlaps this faulted contact in some places (Figure 2b).

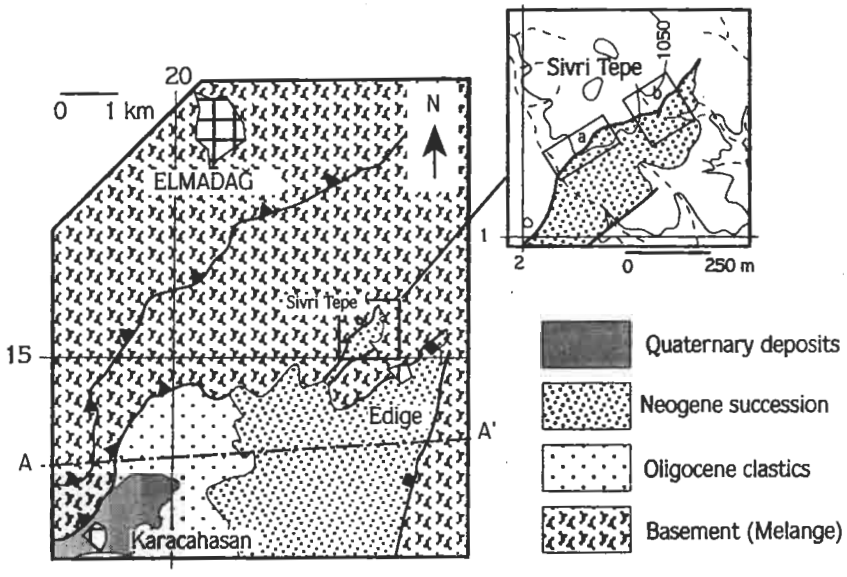


Figure 4. Geological map of Edige. (Simplified and modified from Akyürek et al. 1984)

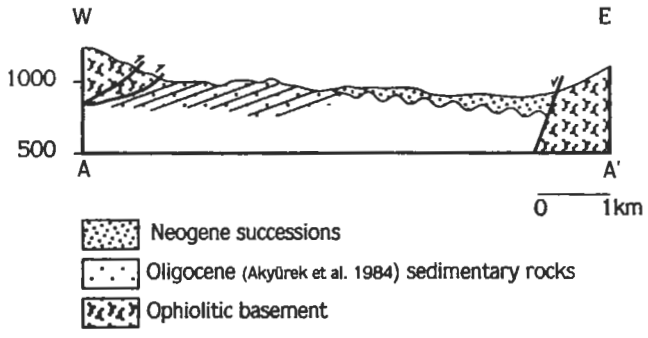
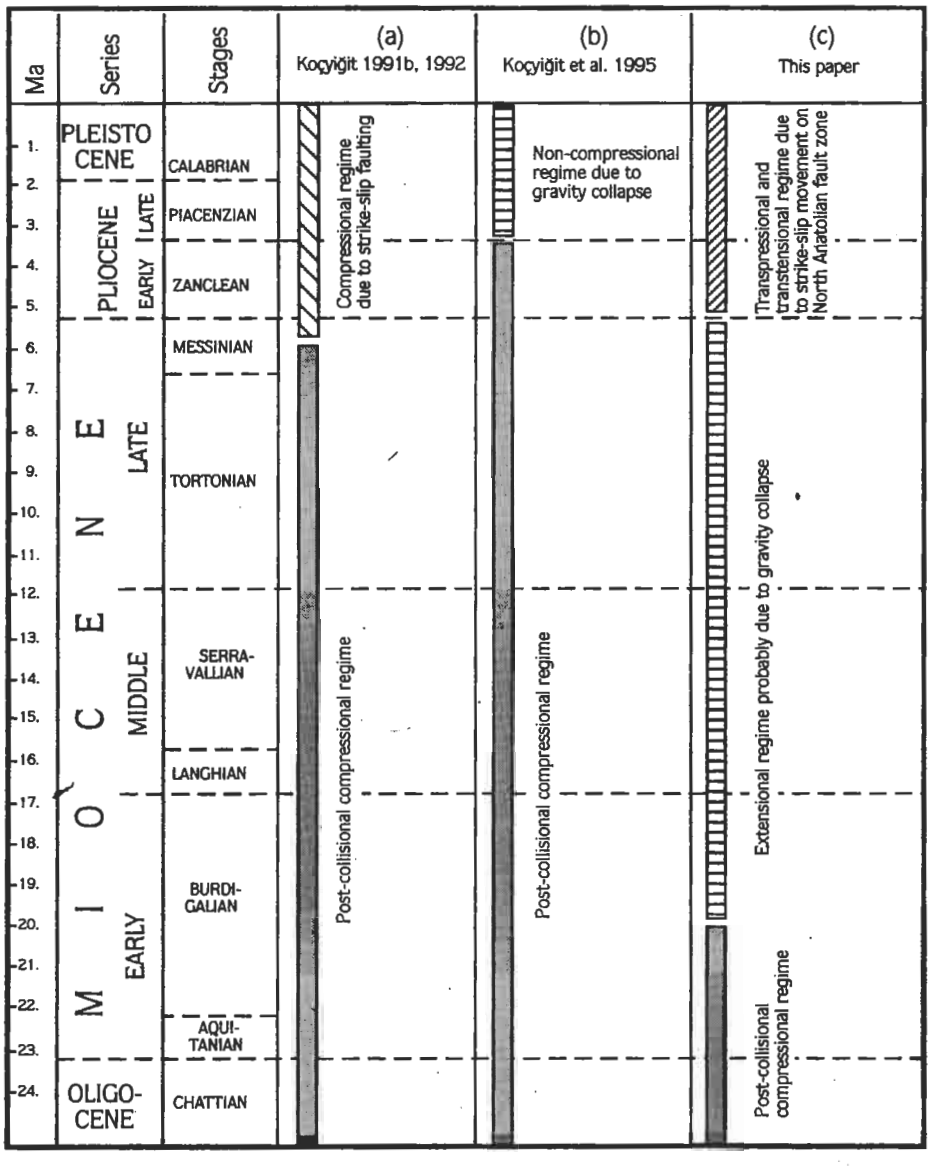


Figure 5. Cross section of Edige half graben. (for location see Figure 4).

NE of Yakacık village: In the 400 m NE of Yakacık village, the reverse fault of Koçyiğit (1991b, Figure 6c) can not be seen between the Neogene sediments and Mesozoic basement. Neogene unit is limited by normal faulting in this area (Figure 3).

Edige village: In the 500 m SE of Edige village, the reported thrust (Koçyiğit, 1991b; Figure 6b) onto the Neogene successions is not observed but it is followed that Neogene sediments, in the SE of Edige, are in a half graben structure (see earlier). The only road to the Edige village has a NW direction and the fourth location mentioned in Koçyiğit (1991b; Figure



a) Koçyiğit 1991 b, 1992
b) Koçyiğit et al. 1995
c) This paper
Chronostratigraphic stage-systems from Steininger & Rögl (1984).

Figure 6. The models proposed for the Late Cenozoic tectonic framework of NW central Anatolia (for discussion see text).

6d) is not found on the road in 2 km northern part of Edige village but in a location 800m NW of Edige, a similar outcrop with Figure 6d of Koçyiğit (1991b) is observed (Figure 4-inset). In this location the border between Neogene and ophiolitic basement is nearly vertical or gives an impression of slight reverse fault in the first sight (Figure 4-inset; area a), however, when the fault surface is closely examined, strike-slip slickensides are apparent but they do not give the sense of movement. Moreover, its continuation towards NE, clearly indicates that fault surface dipping towards SE (Figure 4-inset; area b) as oppose to the 'area a'. These observations could be a reflection of helicoidal geometry of a strike-slip fault surface (Naylor et al., 1986) and not a reflection of reverse fault as suggested by Koçyiğit (1991b) probably at this location.

Our observations conclude that in all locations, especially around Yuva village, the relationship between the basement and Neogene units does not satisfactorily show a compressional regime.

In the NE of Ankara, Koçyiğit et al. (1995) presented additional key areas where Middle Miocene - Lower Pliocene, fining upwards Çandır group (Aslantaş and Hancılı formations) is folded and thrusted by ophiolitic basement (Erol, 1961). As a result of these observations, a compressional regime due to intracontinental convergence is suggested until the Early Pliocene and the following Late Pliocene, non-compressive regime due to gravity collapse is proposed by using the observations on Büyükhacıbey formation (Koçyiğit et al., 1995) (Figure 6b). Although these locations on the NE of Ankara are not visited, following discussion can be made under the light of the data presented by Koçyiğit et al. (1995). If an advancing ophiolite thrust existed during the accumulation of Çandır group in Miocene - Early Pliocene as suggested by Koçyiğit et. al. (1995 Figure 11b), it would create an upward coarsening sequence (Hayward & Robertson, 1982; Figure 5 and López-Blanco, 1993; Figure 4) but the opposite is reported for the Çandır group (see Figure 4 of Koçyiğit et al., 1995). Moreover, the folding of Çandır group does not show the existence of a compressional regime during the accumulation of the sedimentary unit. According to the data presented by Koçyiğit et al. (1995) folding is older than Late Pliocene and younger than early Pliocene. It is also known (Keller et al., 1992) that generally calcalkaline acid- intermediate volcanism took place during Early Miocene whilst alkaline basic volcanism is dominant in Late Miocene. This transition is unlikely under the conditions of the suggested (Koçyiğit et al., 1995) crustal shortening and thickening by thrust sheets during the Miocene.

As a conclusion, our field observations demonstrate no thrusting between the basement and Neogene successions on all the key locations given by Koçyiğit (1991b). In the NE of Ankara the field studies of Koçyiğit et al. (1995) does not provide enough data to show a compressional regime during Miocene - Late Pliocene. Finally the volcanic evolution in the region resemble a thinning (Seyitoğlu & Scott, 1992) rather than a thickening crust during Miocene. Our preliminary field observations and the investigation on the previous studies permit us to produce a hypothesis that the compressive tectonic regime ceased after Oligocene or probably in the earliest Miocene and an extensional tectonics developed during middle to Late Miocene probably due to gravitational collapse and following the Pliocene the effects of transpression or transtension of North Anatolian fault can be seen in the region (Figure 6c).

In order to test this hypothesis a reliable age data base, which will be obtained by isotopic dating, palynology and magnetostratigraphy in the future field studies and careful examination of the contacts between pre-Neogene basement and Neogene successions are necessary.

Acknowledgements

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