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LAKE LEVEL CHANGES AND DEVELOPMENT OF ALLUVIAL FANS IN LAKE TUZ AND THE KONYA BASIN DURING THE LAST 24,000 YEARS ON THE ANATOLIAN PLATEAU, TURKEY

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Alluvial fans developed and lake levels fluctuated several times according to the climatic changes during the last 24,000 years. Alluvial fans developed in Lake Tuz in the cold, pluvial periods of increasing discharge during the Holocene around 5000 yr BP. and after 3500 yr BP. Lake expansion occurred at 23 ka., 18—20 ka.,14—15 ka., and 11 ka. over the last 24,000 years in the Konya Basin. These expansions, shown by the raised lake terraces and beach ridges, were mainly due to cold and pluvial climatic changes. The lake level rose in the colder climate during marine oxygen isotope stage 2 and the Younger Dryas period. The lake level reached its highest level of 1013 to 1014 m during the last Glacial maximum before 18 ka.

Key words: KONYA BASIN, LAKE TUZ, PALEO-KONYA LAKE, LAKE LEVEL FLUCTATION, ALLUVIAL FANS, LAST GLACIAL PERIOD

INTRODUCTION

It is well known that changes in the wet — dry climate as well as the fluctuation of the mean temperature occurred repeatedly during the late Quaternary. Changes of precipitation and evaporation related to wet — dry climatic changes brought lake level fluctuations in the last Glacial age in West Asia (Brice, 1978; Yasuda, 1988). In this area, the cause of a relatively wet climate in the last Glacial age was caused by the southward displacement of the midlatitude jet stream (Dawson, 1992).

Many lakes of closed systems on the Anatolian Plateau have also fluctuated in response to the Quaternary climatic changes (Eroll, 1978). Eroll (1978), Roberts et al. (1979) and Roberts (1983) pointed out that the paleo-lake levels of the Konya Basin and Lake Tuz reached their highest levels during the last Glacial maximum of 18 ka. BP. The authors investigated the geomorphology of alluvial fans, lake strandlines and their sediments in Lake Tuz and the Konya Basin from 1991 to 1992, to identify the geomorphological development and paleo-lake fluctuations due to climatic changes on the Anatolian Plateau. Stratigraphic information for Lake Tuz and the Konya Basin was obtained from exposed deposits in gravel quarries and escarpments. Holocene and Pleistocene deposits within the study area were correlated through

^{14}C dating of terrestrial fossil shells such as *Dreissėna polymorpha*, *Cipangopaludina* sp. and *Allopeas* sp.

OUTLINE OF STUDY AREA

The study area extends from 32° 26′ E to 34° 03′E, and from 37° 30′ N to 39° 09′ N (Fig. 1),

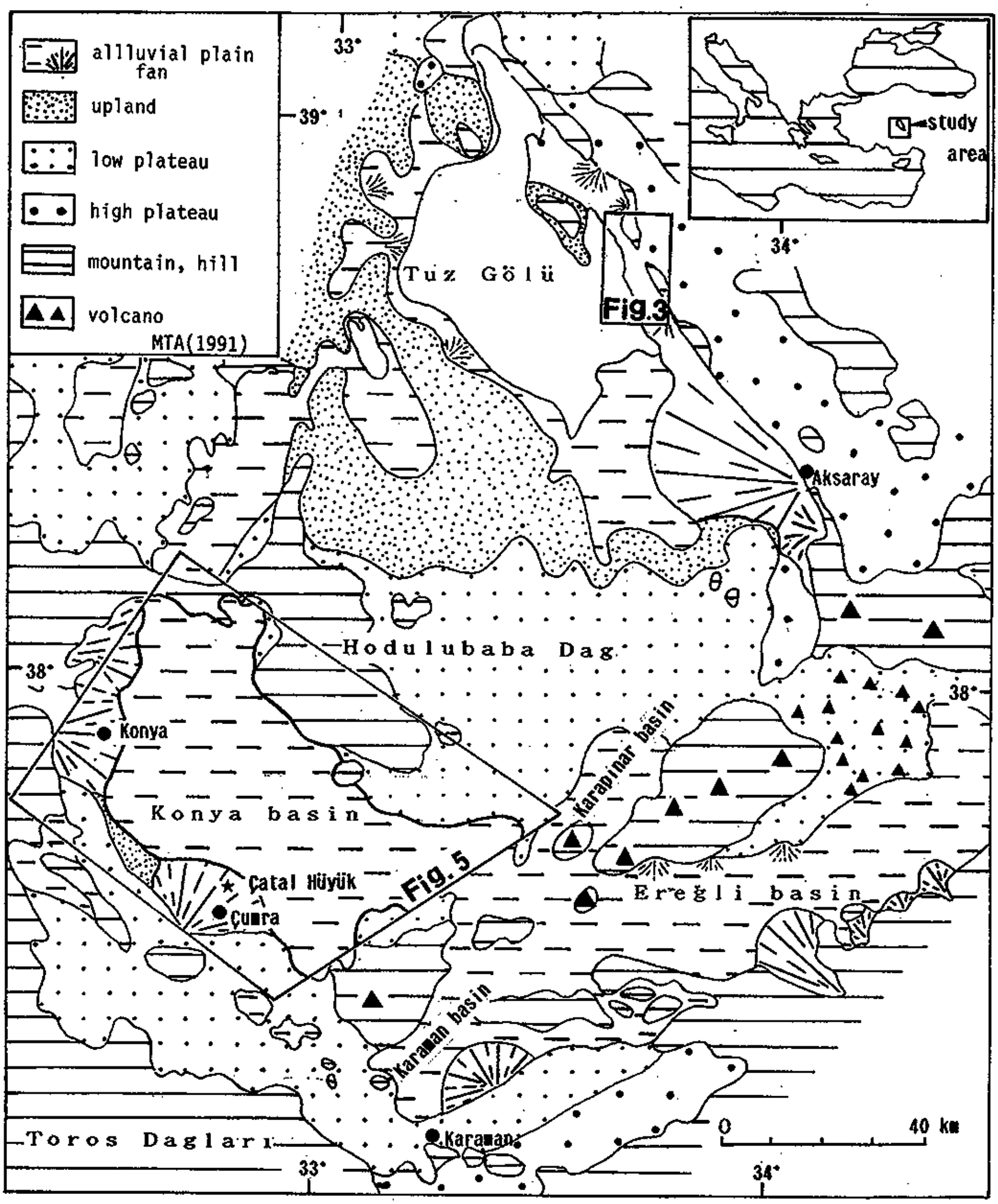

Fig. 1. Location and geomorphological map of the study area (Geomorphological map from M. T. A., 1991).

and is at an altitude of about 900 to 1000 m above sea level. Lake Tuz and Chihanbeyli Basin are located in the northern half of the area. The four basins of Konya, Ereğli, Karaman and Karapınar are located in the southern half of the area.

The Turkish Plate has been lifted continuously since the late Miocene by its collision with the Arabian Plate from the southeast and the subduction of the African Plate from the south. As a result of these tectonic movements, many depressions and erosional low relief surfaces have developed on the Anatolian Plateau (Sugai, 1992; Naruse, 1994).

Many lakes of closed systems developed in the depressions. Lake Tuz and the Konya Basin are also a closed system, without an outlet. Consequently, Lake Tuz became hypersaline water under the dry climate with 200 to 300 mm of precipitation in a year. The presence of few karstic outlets, such as a sink hole, however, has prevented the Konya Basin from becoming hypersaline playa (Roberts, 1983).

It was considered that both Lake Tuz and the Konya Basin were big pluvial lakes; paleo-Tuz Lake and paleo-Konya Lake expanded during the last Glacial age (Eroll, 1978).

Alluvial fans developed on the east side of Lake Tuz. Lake terraces, beach ridges and alluvial fans developed on the periphery of the Konya Basin.

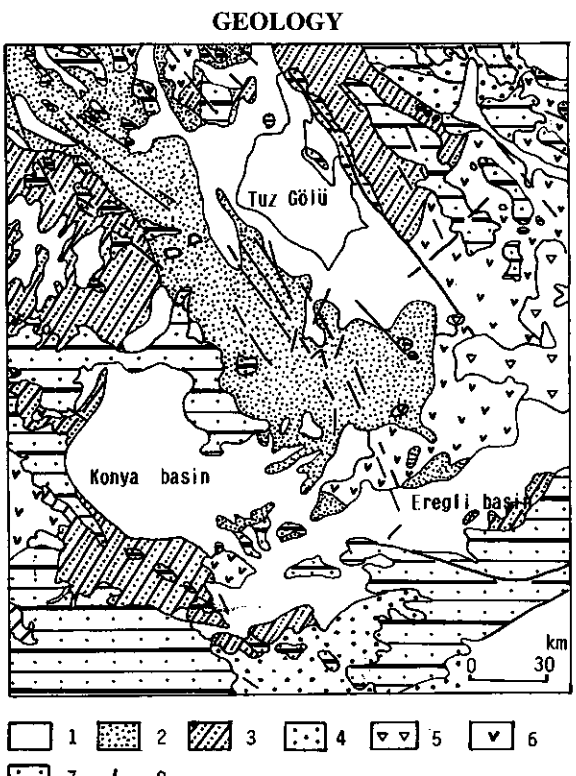

Fig. 2. Geological map of the study area (simplified from M. T. A., 1991).
1: Quaternary 2: Pliocene 3: Neogene 4: pre-Miocene, basement rock
5: Pliocene-Quaternary tuff 6: Miocene-Pliocene tuff, 7: Paleozoic-Mesozoic
8: fault

Pre-Miocene rocks are widely distributed in the study area (Fig. 2). Tertiary rocks are dispersed in hills and in low surface relief areas. Quaternary sediments have accumulated on the basin floor. Active faults are observed at the east side of Lake Tuz. NW — SE faults are predominant in this area.

HOLOCENE ALLUVIAL FANS IN LAKE TUZ

On the east side of Lake Tuz, low relief surfaces are extensively developed in the Eocene rock

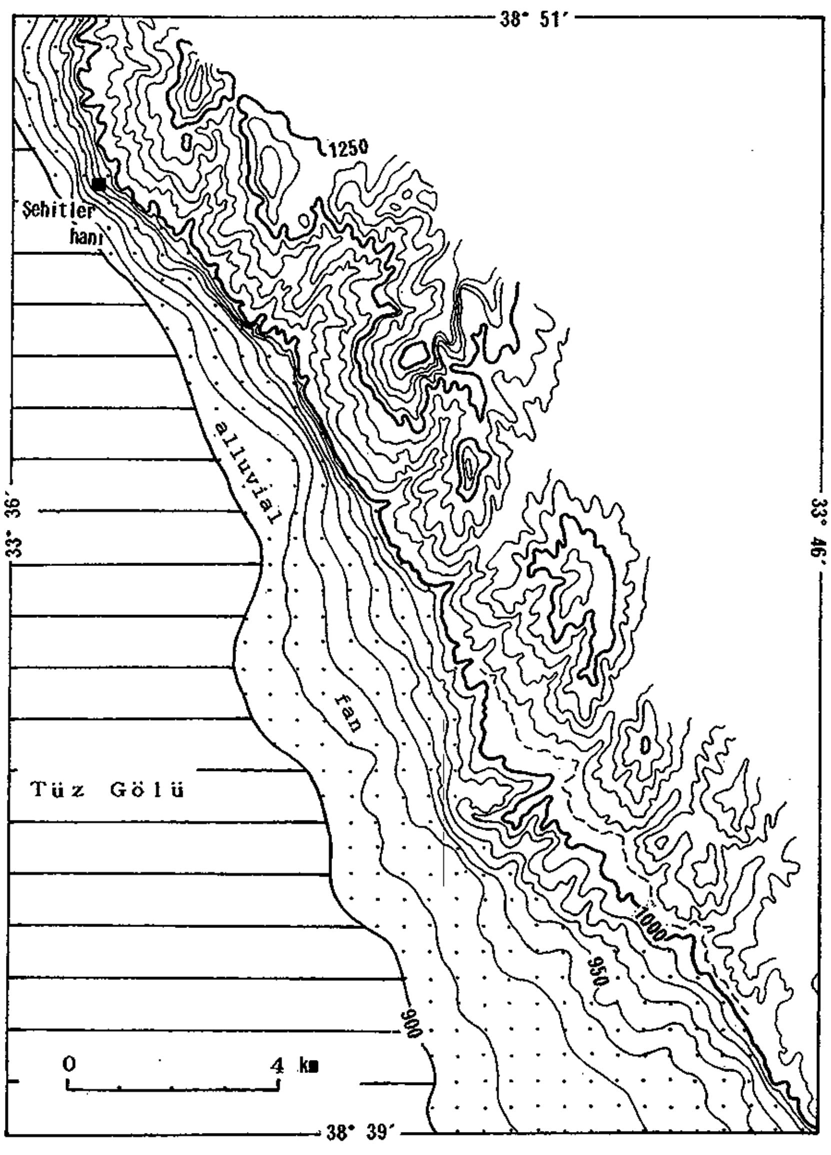

Fig. 3. Contour map of alluvial fans along the eastern shore of Lake Tuz.

area and an active fault scarp extends from NW to SE (Fig. 3).

Confluent fans are spread at the foot of fault scarp with the largest radii about 7 km (Photo. 1).

Photo 1. Lake Tuz in the dry season and alluvial fans

At Şehitler hanı, 38° 48′ 43″ N, 33° 36′ 20″ E, a small alluvial fan with radii of 1.2 km, at an altitude of from 905 to 960 m above sea level, a gentle slope of 3 degrees develops. Today the fan is dissected deeply by a small river.

Three alluvial fan gravel layers were observed in Şehitler hanı at an outcrop of about 10 m high in the gravel quarry on the midfan. (Photos. 2, 3). Tuz Fan I, the lowest gravel layer is at

Photo 2. Outcrop in a gravel quarry at Şehitler hanı.

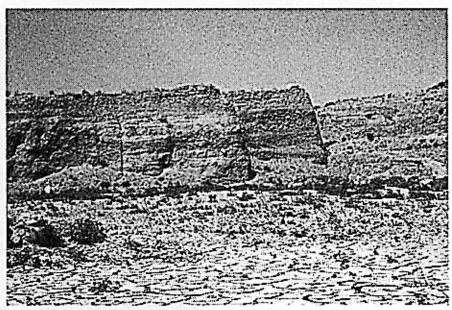

Photo 3. Outcrop in a gravel quarry at Şehitler hanı.

least 8 m thick, consisting of subangular gravels. The maximum gravel diameter is 40 cm, and the mean diameter between 10 and 20 cm. Two silt beds of about 100 cm thick each, are deposited on and in the lowest gravel layer. Fossil terrestrial shells of *Allopeas* sp. which live in wet soil were collected from the silt beds for ^{14}C dating. ^{14}C ages of 5430 yr BP, and 5110 yr BP were obtained from the lower silt bed and the upper silt bed, respectively (Photos. 4, 5). It is clear

Photo 4. Tuz fan I and Tuz fan II in Şehitler hanı.

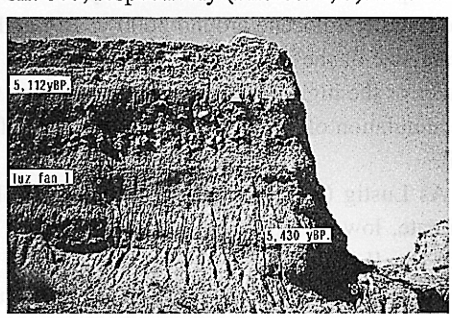

Photo 5. Tuz fan I and ^{14}C ages of silt beds in Şehitler hanı.

from the deposition of the huge alluvial fan gravel layer that a large amount of materials were transported by perennial streams and/or flooding from the upper stream, before 5000 years BP.

Tuz Fan I was dissected slightly and was overlain by the Tuz Fan II gravel layer (Photos. 6, 7).

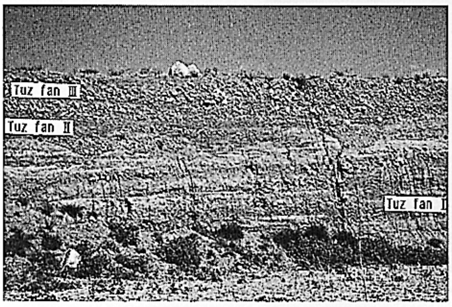

Photo 6. Tuz Fan I, II and III in Şehitler hanı.

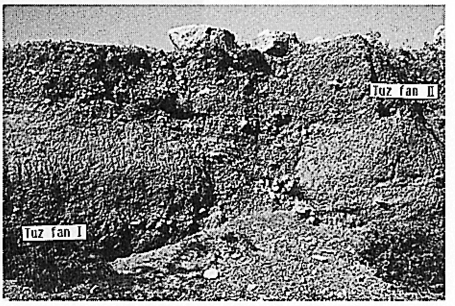

Photo 7. Incized Tuz Fan I by shallow ravine and overlain by Tuz Fan II.

The Middle gravel layer of Tuz Fan II consists of 140 cm thick materials which are fine in comparison with Tuz Fan I. A ^{14}C date of an *Allopeas* sp. which was contained in the upper sand bed of the Tuz Fan II layer was 3580 yr BP. (Photo. 8).

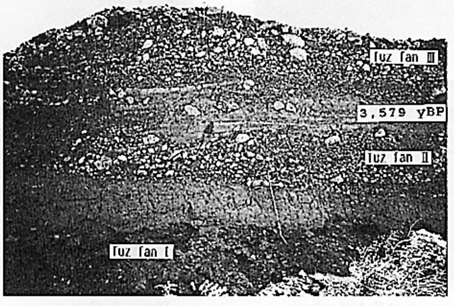

Photo 8. Tuz Fans I, II and III and ^{14}C age of Tuz Fan II.

The upper gravel layer of Tuz Fan III is 100 cm thick, consisting of subangular gravels, with a maximum diameter of 30 cm, and a mean diameter of 5 cm. The Tuz Fan III gravel layer was deposited after 3500 yr BP.

It is possible that the climatic changes are recorded in the alternating three layers of alluvial fan deposits. Tuz Fans I and III may have been deposited under the cold and pluvial climate in the middle Holocene around 5000 yr BP. and after 3500 yr BP., judging from the thickness and grain size of the gravel layers. Two silt beds may have been accumulated under perennial river water or the higher water level of Lake Tuz. On the other hand, the dissection of Tuz Fan I and accumulation of Tuz Fan II which consists of finer gravel suggests a dry climate before 3500 yr BP.

As Lustig (1965) links fan accretion to pluvial or humid conditions, and dissection to arid climate, low precipitation may have created favorable conditions for fan dissection during the Tuz Fan II stage.

To summarize, the results of this analysis suggest that, at the Lake Tuz side, before about 5000 yr BP., river systems were subject to increasing discharge and the large Tuz Fan I developed under the pluvial climate. At 3500 yr BP., the Tuz Fan I was dissected and finer materials were deposited on the Tuz Fan I under the dry climate. After 3500 yr BP. Tuz Fan III developed under a wetter climate.

CHRONOLOGY OF THE ALLUVIAL FANS AND LAKE TERRACE OF THE KONYA BASIN

The Konya Basin is surrounded by mountains, hills and eroded surfaces. It has only 250 to 350 mm of annual precipitation. The rivers originating in the Toros mountains, with more than 1000 mm of precipitation, flow into the basin and form the most fertile agricultural land on the Anatolian Plateau.

Rivers form alluvial fans and delta plains in the southern and western periphery of the basin. In the northern peripheries of the basin, lake terraces and raised beach ridges have developed (Fig. 4).

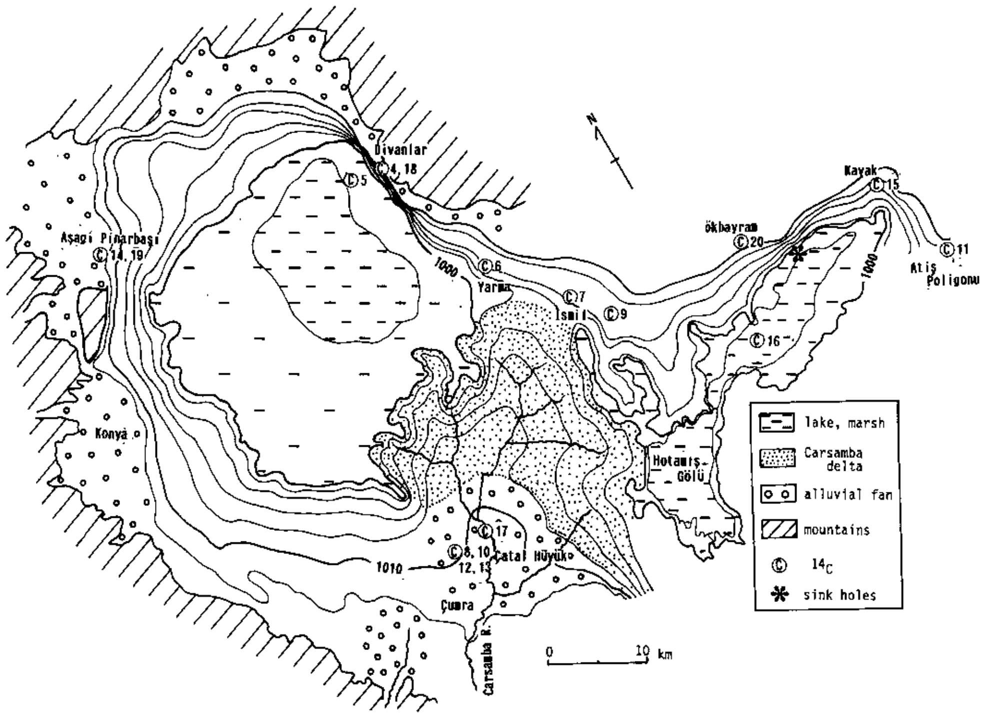

Fig. 4. Geomorphological map of the Konya Basin.

The depositional sequence of alluvial fan, lake terrace, raised beach ridges, and delta are classified into 7 levels as follows, from Konya I to Konya VII, using ^{14}C dates of fossil shells of *Dreissena polymorpha* and *Cipangopaludina* sp. found in the deposits (Table 1). Dates of these layers are as follows: I:$>$23 ka., II:21 ka., III:18 — 20 ka., IV:15 — 16 ka., V:14 — 15 ka., VI:10 — 12 ka., and VII:$<$10 ka.

Table 1. ^{14}C dates in Konya Basin and Lake Tuz, Turkey.

No.	field site	location (° ′ ″ , ° ′ ″)	laboratory No.	^{14}C age(yr. B. P.)	sample
	Tuz fan II				
1	Sehitler hanı	38 48 52N, 33 36 16E	NUTA-IFC	3,579+ 97, -96	*Allopeas* sp.
	Tuz fan I				
2	Sehitler hanı	38 48 52N, 33 36 16E	NUTA-IFC	5,112+ 168, -165	*Allopeas* sp.
3	Sehitler hani	38 48 52N, 33 36 16E	NUTA-IFC	5,430+ 167, -163	*Allopeas* sp.
	Konya VI				
4	Divanlar	37 56 45N, 32 54 07E	JAS-71	10,950+ 460, -440	*Cipangopaludina* sp.
5	Acidort	37 58N, 32 52E	GrN-5841	10,950± 65	shell
6	Yarma	37 48N, 32 58E	GrN-6016	12,010± 65	shell
	Konya V				
7	Dervişin Hani	37 45N, 33 05E	HUR-41	14,270± 550	shell
8	Çumra 19-11	37 36 49N, 32 47 29E	JAS-46	14,670+1,040, -920	*Dreissena polymorpha*
9	İsmil	37 44 13N, 33 03 31E	JAS-72	15,350+ 560, -520	*Dreissena polymorpha*
	Konya IV				
10	Çumra 19-14	37 36 49N, 32 47 29E	JAS-57	15,900+1,120, -980	*Dreissena polymorpha*
11	Atiş Poligonu	37 38 18N, 33 25 55E	JAS-59	16,540+ 520, -490	*Dreissena polymorpha*
12	Çumra	37 36 49N, 32 47 29E	JAS-47	16,680+ 500, -470	*Dreissena polymorpha*
	Konya III				
13	Çumra 19-13	37 36 49N, 32 47 29E	JAS-58	18,690+ 630, -580	*Dreissena polymorpha*
14	Aşağı Pınarbaşi	37 59 47N, 32 35 50E	JAS-77	19,117+ 820, -750	*Dreissena polymorpha*
15	Kavak	37 42 50N, 33 23 07E	JAS-73	20,220+ 670, -620	*Dreissena polymorpha*
16	Hotamiş	37 39N, 33 11E	GrN-5729	20,700± 450	shell
	Konya II				
17	Kumocaği	37 37N, 32 48E	GrN-6014	21,370± 215	shell
18	Divanlar	37 56 45N, 32 54 07E	JAS-90	21,720+1,440, -1,220	*Dreissena polymorpha*
	Konya I				
19	Aşaği Pınarbaşı	37 59 47N, 32 35 50E	JAS-81	>22,300	*Dreissena polymorpha*
20	Gökbayram	37 43 06N, 33 13 58E	JAS-74	23,740+1,440, -1,220	*Dreissena polymorpha*

GrN and HUR: after Robert(1983)

(1) Alluvial fan chronology in the Konya Basin

1)Alluvial fan in Çumra

The Çarşamba River, which flows from Lake Bayşehir, forms an alluvial fan and delta plain in Çumra. The site of Çatal Hüyük is located on the outer fan margin. A delta plain has developed from 1000 to 1008 m above sea level in front of the alluvial fan.

Gravel quarries were excavated at the midfan near Çumra (Photo. 9). Five meter high sections

Photo 9. Outcrop of alluvial fan in a gravel quarry at Çumra.

of alluvial fans were observed, I, II, and III, at gravel quarries (37° 36′ 49″ N,32° 47′ 29″ E) (Fig. 5). Konya I and II layers could not be identified in these sections; however, Roberts (1983) reported that Konya II dates to 21,370±215 yr BP. (GrN — 6014) at Kumoçağı near Çumra.

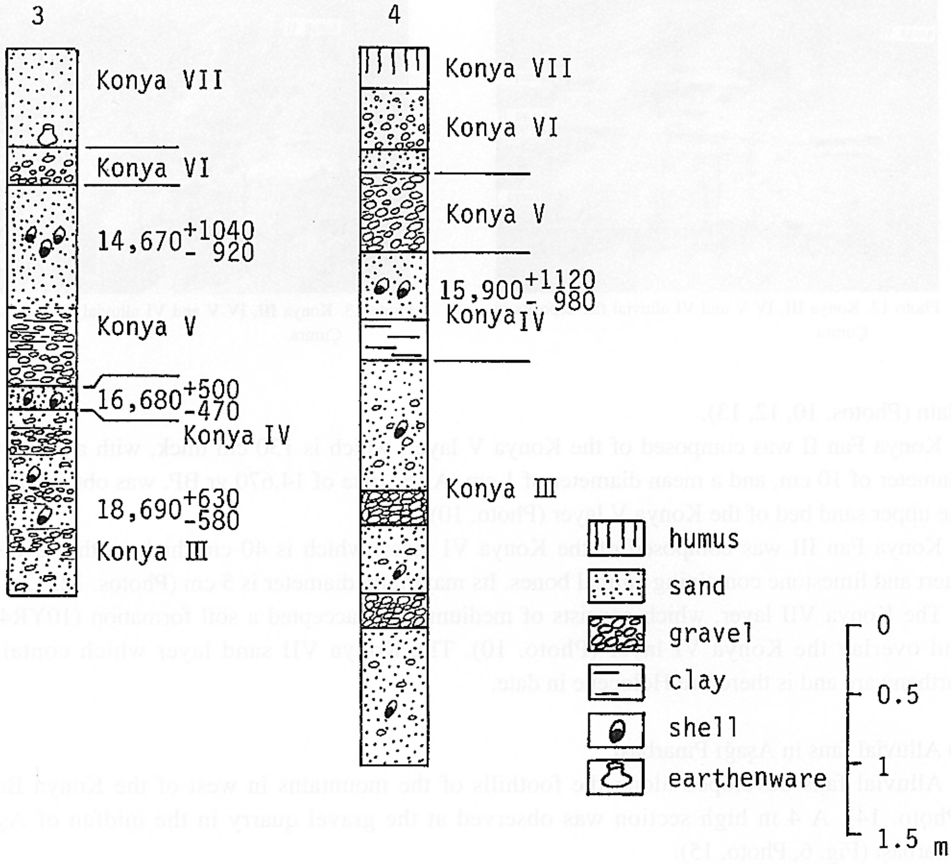

Fig. 5. Stratigraphic sections of alluvial fan sediments and paleo-lake sediments in Konya Basin.

Konya Fans I, II and III all consist of alluvial fan gravels. Konya Fan I was composed of the Konya III layer which is >2 m thick, consting of well sorted, stratified rounded gravels, with a mean diameter of <3 cm (Photos. 10, 11). A ^{14}C age of 18, 690 yr BP. was obtained from the Konya III layer.

The Konya IV layer, which is 10 to 30 cm thick, consists of alternating white marl, clay and sand, and dates to between 15,900 and 16,680 yr BP. The Konya IV layer is a deposit of delta

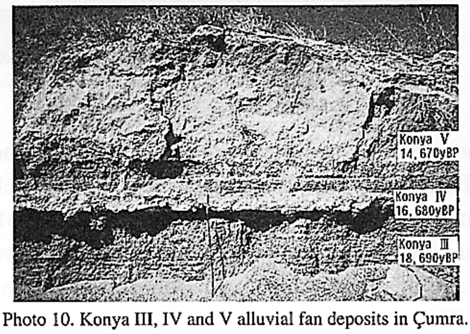

Photo 10. Konya III, IV and V alluvial fan deposits in Çumra.

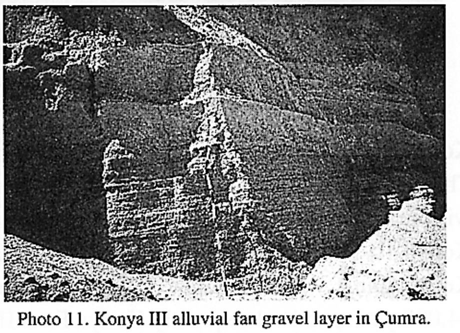

Photo 11. Konya III alluvial fan gravel layer in Çumra.

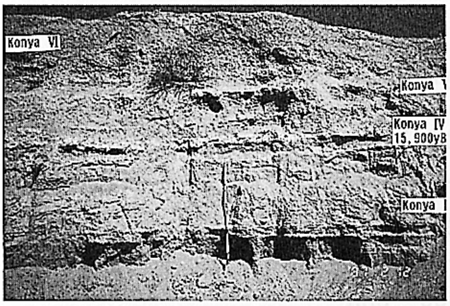

Photo 12. Konya III, IV V and VI alluvial fan deposits in Çumra.

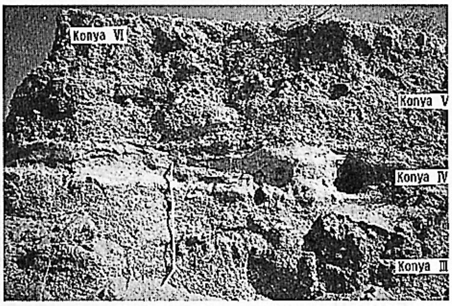

Photo 13. Konya III, IV V and VI alluvial fan deposits in Çumra.

plain (Photos. 10, 12, 13).

Konya Fan II was composed of the Konya V layer, which is 130 cm thick, with a maximum diameter of 10 cm, and a mean diameter of 1 cm. A ^{14}C date of 14,670 yr BP. was obtained from the upper sand bed of the Konya V layer (Photo. 10).

Konya Fan III was composed of the Konya VI layer, which is 40 cm thick, with gravels of chert and limestone containing animal bones. Its maximum diameter is 5 cm (Photos. 12, 13).

The Konya VII layer, which consists of medium sand, accepted a soil formation (10YR4/2), and overlay the Konya VI layer (Photo. 10). The Konya VII sand layer which contained earthenware and is therefore Holocene in date.

2) Alluvial fans in Aşağı Pınarbaşı

Alluvial fans developed along the foothills of the mountains in west of the Konya Basin (Photo. 14). A 4 m high section was observed at the gravel quarry in the midfan of Aşağı Pınarbaşı (Fig. 6, Photo. 15).

Photo 14. Dissected alluvial fan at Aşağı Pınarbaşı in western Konya Basin.

Photo 15. Konya I and III alluvial fan deposits in Aşağı Pınarbaşı.

Konya I (>22,300 yr BP.), the lowest layer is Konya Fan I consisting of coarse laminated sand. The sand layer is overlaid by Konya III. Konya III is composed of gravel which is 3 m thick, with a maximum diameter of 15 cm, mean diameter of <5 cm, and dated to 19,120 yr BP. Konya III consists of rounded gravels of chart, sandstone and limestone. As described above, Konya Fan I was developed in the maximum stage of alluvial fan formation during the last 24,000 years, and subsequently Konya Fans II and III.

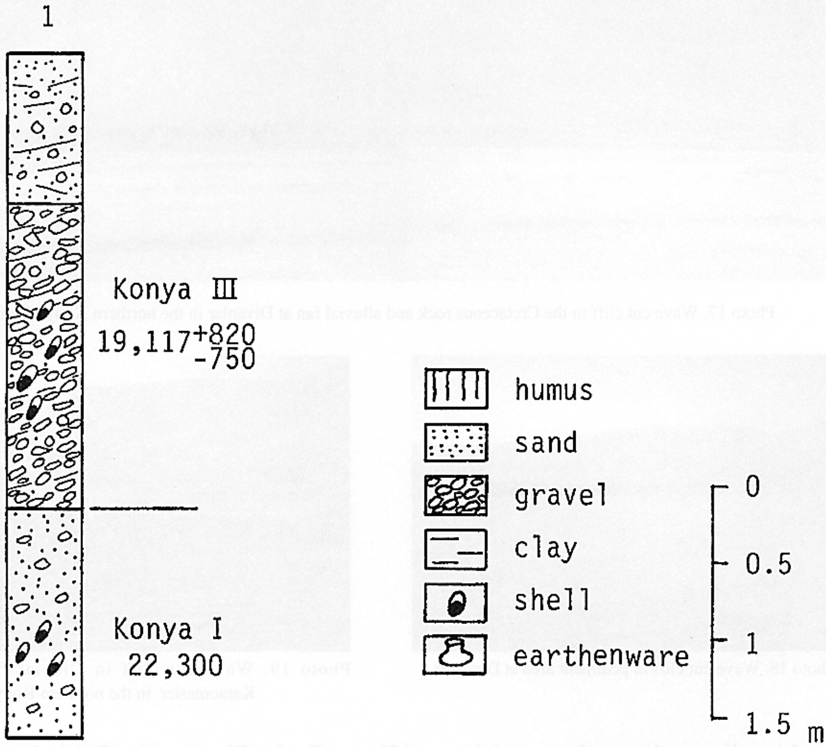

Fig. 6. Stratigraphic sections of alluvial fan sediments and paleo-lake sediments in Konya Basin.

These three periods are characterized by a drastic increase in river discharge with flood water during marine oxygen isotope stage 2 and the Younger Dryas, whereas the period of Konya IV saw a change to into a deltaic environment.

(2) Lake terraces and beach ridges in the Konya Basin.

1) Ages of four accumulation terraces

Abraded base rocks of a cliff cut by waves, along with pediments and alluvial fans were

Photo 16. Wave cut cliff in the Cretaceous rock at Divanlar in the northern Konya Basin.

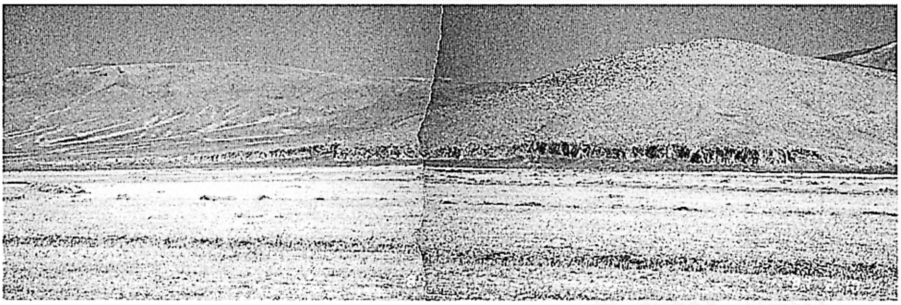

Photo 17. Wave cut cliff in the Cretaceous rock and alluvial fan at Divanlar in the northern Konya Basin.

Photo 18. Wave cut cliff in pediment area at Divanlar.

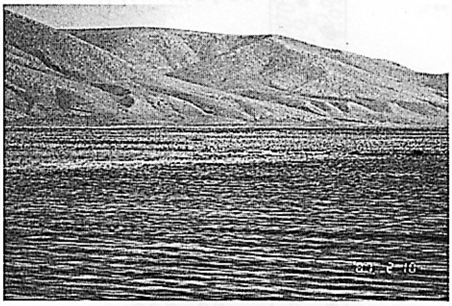

Photo 19. Wave cut cliff in alluvial fans area at Karaomerler in the northern Konya Basin.

observed in a line at the northern periphery of Konya Basin (Photos. 16, 17, 18, 19). Strandlines which showed the paleolake level, with lake terraces and raised beach ridges, were also observed at the northern periphery.

In the Konya Basin, five lake terraces can be identified on the basis of altitude and ^{14}C chronology: >1025 m, 1017 m, 1010 — 1015 m, 1006 m, 1002 m.<1000 m areas are swamp and shallow depressions.

Fig. 7 illustrates the generalized stratigraphic and chronological relationships in cross section. Among these terraces, the >1025 m terrace is a low relief erosional surface within the base rock area (Photo. 20). All other surfaces are accumulation terraces.

1017 m terrace

The 1017 m terrace was composed of a rounded and stratified gravel layer >5 m thick. It was

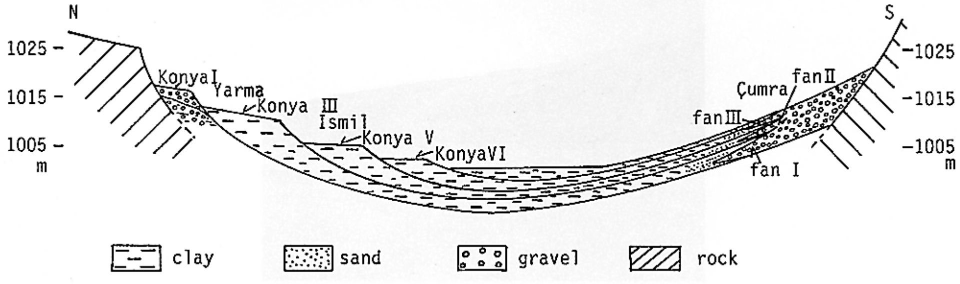

Fig. 7. Cross section of terraces, alluvial fans and their sediments.

Photo 20. >1025 m terrace of low relief erosional surface in the Cretaceous rock at Aşağı Pınarbaşı.

not possible to obtain ^{14}C date from the sediment, but Roberts (1983) reported a ^{14}C date of 32,350±410 yr BP. (GrN-6015) from the nearshore sandy gravel layer of 1017 m terrace at Merdivan (37° 44′ N, 33° 13′ E). The ^{14}C date is the minimum age, which may be correlated with the marine oxygen isotope stage 3.

1010 — 1015 m terrace

This terrace developed extensively in the northern periphery of the basin. Roberts (1983) called the terrace at the level of 1010±5 m the "Main terrace".

In Gökbayram (Fig. 8), a 6 m high section was observed. The terrace was composed of Konya I and II. The Konya I gravel layer was deposited between 1010 m at the base of the outcrop and 1013 m. A date of 23,740 yr BP. was obtained from Konya I (Photo. 21). Konya I consists of stratified, well sorted, rounded beach gravel, with a maximum gravel diameter of 3 cm. The

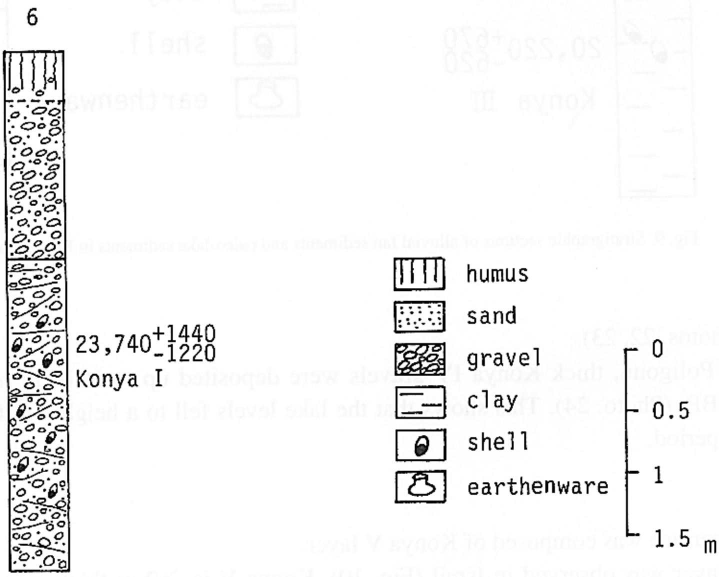

Fig. 8. Stratigraphic sections of alluvial fan sediments and paleo-lake sediments in Konya Basin.

Photo 21. 1010-1015 m terrace deposits at Gökbayram.

unstratified Konya III gravel that overlay Konya I was observed between the height of 1013 and 1015 m. Konya III was made of beach ridge gravel which was 2 m thick.

Based on an assumption that the upper limit of wave run-up was between 1 and 2 m, the strandline of Konya I was estimated at between 1011 and 1012 m, and that of Konya III was 1013 and 1014 m.

Lacustrine clay of Konya III was found in Kavak at an elevation of 1007 m and dated to 20,220 yr BP. (Fig. 9). Konya III consists of >3 m thick clay which was deposited on the lake

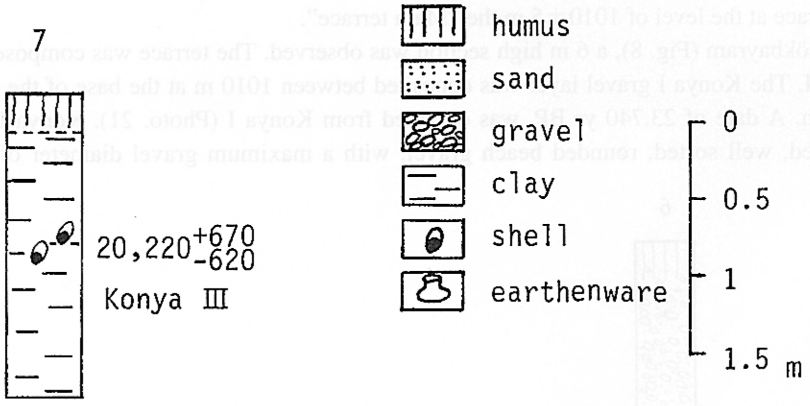

Fig. 9. Stratigraphic sections of alluvial fan sediments and paleo-lake sediments in Konya Basin.

bottom (Photos. 22, 23).

At Atiş Poligonu, thick Konya IV gravels were deposited up to 1010 m high and dated to 16,540 yr BP. (Photo. 24). This shows that the lake levels fell to a height of 1010 m during the Konya IV period.

1006 m

1006 m terrace was composed of Konya V layer.

Konya V layer was observed in İsmil (Fig. 10). Konya V is >2 m thick, consists of clay, and dated to 15,350 yr BP.

Photo 22. 1010-1015 m terrace consists of clay at Kavak ^{14}C: 20,220 yr BP.

Photo 23. 1010-1015 m terrace clay and *Dreissena polymorpha* at Kavak.

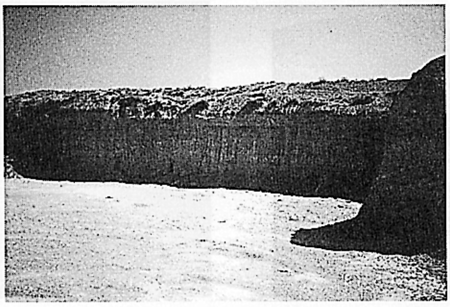

Photo.24 Konya IV gravel layer at Atiş Poligonu ^{14}C age: 16,540 yr BP.

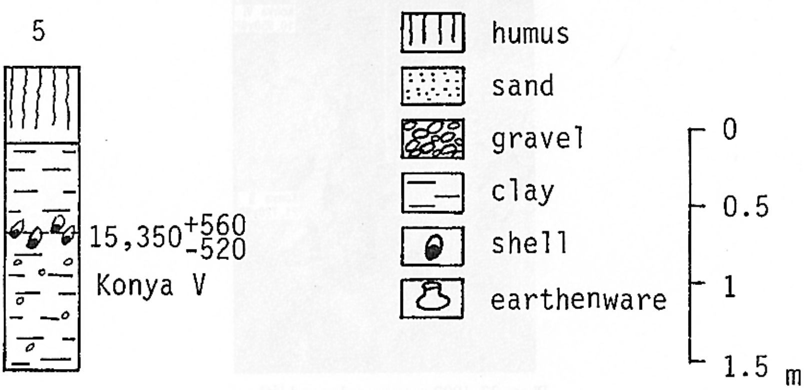

Fig. 10. Stratigraphic sections of alluvial fan sediments and paleo-lake sediments in Konya Basin.

1002 m

Sediment of 1002 m terrace was observed in Divanlar (Fig. 11). Grey clay of >2 m thick was deposited, *Dreissena Polymorpha* at a depth of 120 cm showed a ^{14}C date of 21,720 yr BP, and

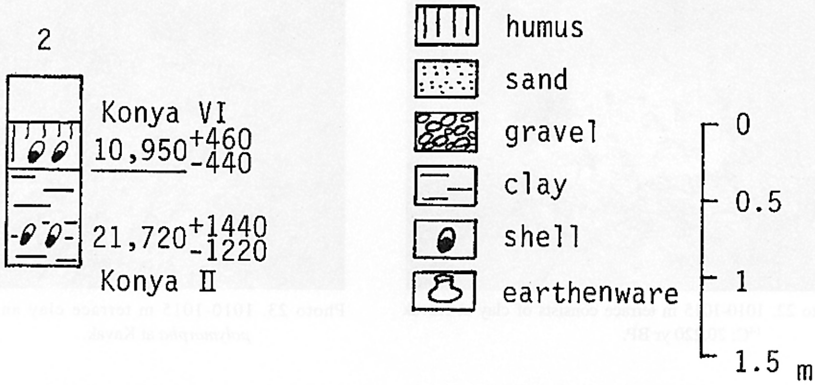

Fig. 11. Stratigraphic sections of alluvial fan sediments and paleo-lake sediments in Konya Basin.

Cipangopaludina sp. at a depth of 40 cm showed a date of 10,950 yr BP. (Photos. 25, 26, 27).

Photo 25. 1002 m terrace at Divanlar.

Photo 26. 1002 m terrace deposit consists of clay at Divanlar.

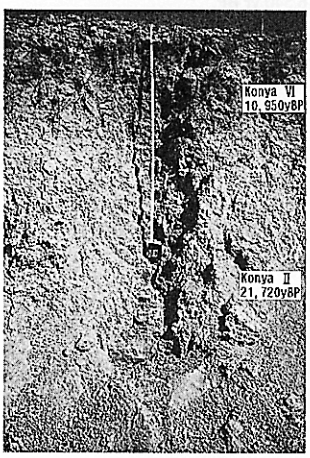

Photo 27. 1002 m terrace clay and ^{14}C ages
Scale in a meter.

(3) Paleo-Konya lake fluctuation

The lake terraces and beach ridges of the Konya Basin show the existence of four significant

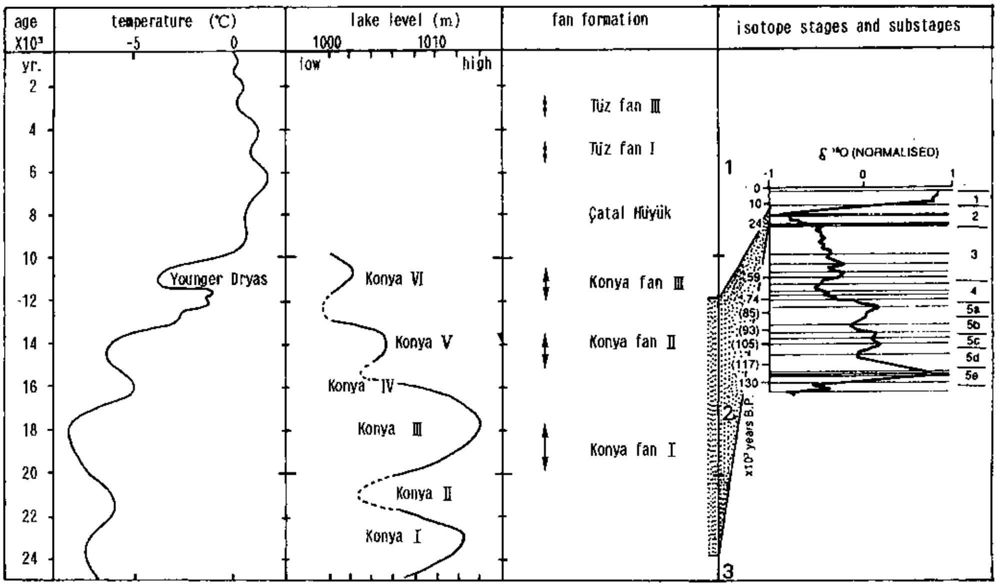

Fig. 12. Chronology of fluctuation of lake level and fan formation for Konya Basin and Lake Tuz.

events of a rise in lake level during the last 24,000 years, as shown in Fig. 12. On the basis of lake evolution, the last 24,000 years can be divided into the following four high lake level phases:

Phase I (Konya I, 23 ka.)

This phase is the beginning of marine oxygen isotope stage 2, when influent river water increased and a paleo-Konya lake was formed. Lake level records are unfortunately rare for this period, although Roberts (1983) suggested that the lake expanded dramatically at this time. The data indicates that the lake level reached a height of 1011 to 1012 m. Following Phase I, in Konya II, the lake level dropped slightly, although, the exact degree of lowering is unknown.

Phase II (Konya III, 18 — 20 ka.)

During the last Glacial maximum, the lake had the largest surface area of anytime during the last 24,000 years. The lake was very extensive and the lake level reached an elevation of 1013 — 1014 m. Following Phase II, in Konya IV, the lake level fell to an elevation of around 1010 m.

Phase III (Konya V, 14 — 15 ka.)

At the end of marine oxygen isotope stage 2, the lake level rose again as high as 1006 m.

Phase IV (Konya VI, 11 ka.)

At the end of the last Ice age around 11 ka, the lake level rose slightly to an elevation of 1002 m. The lake surface areas were small and rather localized. Phase IV corresponds to the Younger Dryas period. In the Holocene, the lake shrank dramatically, and subsequently disappeared as a result of the warmer climate. We could not find any evidence of high water lake levels in this period.

RELATIONSHIP BETWEEN CLIMATIC CHANGE AND DEVELOPMENT OF ALLUVIAL FANS AND LAKE TERRACES

As mentioned above, alluvial fans and lake terraces have developed in the periphery of Konya Basin during the last 24,000 years. The periods of alluvial fan formation and high water levels of paleo-Konya Lake are closely connected with climatic changes as shown in Fig. 12. It seems that depositions of alluvial fan and a high water level correspond with the colder periods. On the contrary, alluvial fans were dissected and lake levels fell in the warmer periods.

Lake water levels became higher in the isotope stage 2, and reached the highest position of 1013 to 1014 m above sea level during the last Glacial maximum. Such a high lake level during the isotope stage 2 on the Anatolian Plateau was caused by a southward displacement of the midlatitude jet stream. Increased rainfall and decreased evaporation may have contributed to the widespread development of the lakes. On the contrary, when the discharge from sinkholes in the Konya Basin exceeded the inflow from rivers, the lake level dropped quickly to the elevation of the sinkholes which were 1002 to 1004 m high above sea level.

Discharge of many of the rivers increased dramatically in the wet and pluvial periods between 24,000 and 11,000 yr BP., as well as during the colder periods in the Holocene. Perennial streams in the pluvial climate took material far from the mountains and deposited coarse materials in the basin. The growth of alluvial fans was initiated in the early stage of the colder periods when the climate was more humid (pluvial). The increased discharge to Lake Tuz during the colder period of 5000 yr BP. may also have resulted in the occurence of floods and deposited a huge Tuz Fan I gravel. On the other hand, low precipitation created favorable conditions for fan dissection.

CONCLUSION

Palaeohydrological changes on the Anatorian Plateau took place in isotope stage 2. The river systems were subjected to changes in discharge due to the shift of the jet stream.

1)Among the alluvial fans which developed along the sides of Lake Tüz, Tüz Fan I developed between 5100 and 5400 yr BP. The period with formation of Tüz Fan I was associated with the humid, intense rainfall in the colder climate of the middle Holocene. Tüz Fan III was also deposited under the humid and pluvial climate after 3500 yr BP.

2) The depositional sequence in the Konya Basin was identified, and then classified into seven layers from Konya I to Konya VII. The dates of these layers are as follows: I>23 ka., II:21 ka., III:18 — 20 ka., IV:15 — 16 ka., V:14 — 15 ka., VI:10 — 12 ka., VII:<10 ka. as shown in Table 1.

3) Alluvial fans developed during the initial stages of the colder period of the last 24,000 years; Konya Fan I: 18 — 20 ka., Konya Fan II: 14 — 15 ka and Konya Fan III: 11 ka. in the Konya Basin. It is clear that the changes in the fluvial activity began soon after 24,000 yr BP and lasted until 11,000 yr BP in the Younger Dryas.

4) Lake terraces can be classified into five units: >1025 m, 1017 m, 1010-1015 m, 1006 m, 1002 m.>1025 m terrace is a low relief erosional surface. Other terraces are correlated as follows; 1017 m terrace: isotope stage 3, 1010 — 1015 m terrace: last Glacial maximum of 18 ka, 1006 m terrace: 14-15 ka, 1002 m terrace: 11 ka.

5) In the Konya Basin, four major transgressive phases (rising and relatively high water levels) have been defined. Paleo-Konya Lake expansion within the last 24,000 years occurrd at 23 ka., 18-20 ka., 14-15 ka., and 11 ka. The transgressive phases recorded in the lake correspond to the colder period, while the regressive phase corresponds to the warmer period. The lake level reached its maximum height of 1013 to 1014 m in the last Glacial maximum. The results obtained are very much in agreement with the results presented by Roberts (1983) with the exception of Konya V.

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トルコ、アナトリア高原、トゥズ湖とコンヤ盆地における過去24,000年間の湖水位変動と扇状地の形成

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要旨：アナトリア高原にあるトゥズ湖とコンヤ盆地では、過去24,000年間に数回にわたって扇状地が形成され、湖水位が変動した。

トゥズ湖岸に発達する扇状地は完新世の5000年前頃と、3500年前頃の寒冷湿潤気候下で形成された。コンヤ盆地に存在した古コンヤ湖と扇状地は、最終氷期の24,000年前から11,000年前の間に形成された。コンヤ盆地では23,000年前に寒冷化が進み、ポーラーフロントが南下したため、アナトリア高原が湿潤化し、Kanya Ⅰの時期を迎え、湖水位が1012mに高まった。この後、21,000年前の Konya Ⅱの時代になるとやや気温が上昇し、湖水位が低下した。最終氷期最盛期である18,000～20,000年前の Konya Ⅲの時代には、Konya Ⅱの時期よりもさらに湖水位が高まり、その高さは1013-1014mに達した。そして盆地の縁辺には扇状地Ⅰが形成された。16,000年前の Konya Ⅳになって湖水位が若干低下したものの、14,000-15,000年前の Konya Ⅴには再び1006mに高まった。そして扇状地Ⅱが形成された。この様に世界的に寒冷な時期である MIS 2 はアナトリア高原が湿潤化し、湖水と扇状地が形成される時代であった。

MIS 2 が終わり、地球全体が温暖化する途上で、最後の寒冷化の揺り戻し Younger Dryas 期（11,000年前）に古コンヤ湖は再び湖水位が高まり、湖水位は1002mとなった。そして扇状地Ⅲが形成された。完新世になるとさらに温暖化し、アナトリア高原は乾燥気候が卓越するようになった。コンヤ盆地にはもはや氷期中のような大湖水が出現することなく、湖水域は年々縮小していった。