PRELIMINARY RESULTS OF RADIOCARBON DATING OF COASTAL DEPOSITS OF THE PLEISTOCENE PLUVIAL LAKE OF BURDUR, TURKEY

MEHMET KIS*
OGUZ EROL**
SERAP SENEL*
MEHMET ERGIN*

SUMMARY: In this study, late quaternary transgresional and regression phases of the Burdur Lake has been determined by C-14 Dating. Dreissensia shells from various level coastal deposits of Burdur Lake were collected. These shells were first converted to CO_2 with %40 phosphoric acid and then to acetylene and benzene respectively. Then the benzene samples were dated after being counted in a scintillation spectrometer. The ages of the samples were found to be between 12,380-28,452 years B.P. According to these radiocarbon datings it is found that in 25,000-30,000 years B.P. the earlier transgressional deposits of the lake laid down ant 900-910 m, at 25,000-20,000 years B.P. the lake surface reached its highest level of 920-925 m and lowered with oscillations between the years 20,000-10,000 years B.P.

Key Words: Radiocarbon Dating, Dreissensia Shells.

INTRODUCTION

Information about the Burdur Pleistocene Pluvial Lake is known for a long time (1,2,3). In his studies (4-12) between the years 1972-1984, Erol found several lake shoreline traces between the heights 854 m to 1100 m. The basin was open to the sea previously, but due to the tecktonic movements in the mid-pleistocene period it became closed. According to the C-14 dating of some samples form the 930-870 metre shorelines it was thought that they are of würm pluvial age. To confirm these findings samples from the region were collected by the authors systematically. Meanwhile two samples taken by Robert (sample no's 10, 11 in Table 1).

Were dated in the laboratories of institute of Geography, University of London, England and a peat sample which was collected by Erol and dated by Geyh (sample no 5 in Table 1) in Laboratorium Niedersachsisches Landesamt für Bodenforschung, Hannover, Germany are also considered in this study. Dating of archeological samples taken from Hacilar previously also showed that the pluvial lake has receeded back considerable in the early Holocene and inhabition existed around it.

MATERIALS AND METHODS

Dreissensia shells were cleaned from other materials by physical pretreatment. Then sand and soil particles stuck onto the shells were cleaned by brushes. Then these samples were treated with diluted HCI till they lost 13 to 15% of their weights (13). During this process the shell samples were stirred continuously so that acid reacted with each shell evenly. After this chemical pretreatment, the samples were washed with distilled water and dried in an oven at 110°C.

Samples are first converted to CO_2 in a reactor after reaction with phosphoric acid, then to lithium, carbide and finally converted to acetylene. The acetylene obtained is converted to spectral

*From Department of Chemistry, Hacettepe University Ankara and
** Deniz Bilimleri ve Cografya Enstitüsü, Müsküle Sok. No: 1 Vefa 34470, Istanbul, Türkiye.

Table 1: Radiocarbon Dating Results of the Samples Taken from the Burdur Lake Basin.

Sampling Level (±3 metres)		Location	Sample Code		Age B.P. (years)
1.	925	Üveyik Tepe	HÜR	79	23957±150
2.	920	Bozanönü	HÜR	78	22153±157
3.	920	Bagtasi	HÜR	73	21639±155
4.	920	Soganli (upper)	HÜR	77	20958±175
5.	915	Hacilar Bozçay	Geyh*		15365±155
6.	910	Kocadere	HÜR	80	28452±170
7.	910	Kocadere	HÜR	82	27662±165
8.	910	Kocadere	HÜR	76	27152±170
9.	905	Tozlu Tepe	HÜR	87	12380±158
10.	905	Tozlu Tepe	Roberts	1*	11000
11.	900	Soganli (lower)	Roberts	2*	28000
12.	900	Soganli (lower)	HÜR	86	28444±160
13.	900	Soganli (lower)	HÜR	84	28013±155
14.	900	Soganli (lower)	HÜR	75	25485±162
15.	893	Kösk Tasi	HÜR	81	13218±160
16.	870	Ev Tepe	HÜR	74	14218±170
17.	870	Ev Tepe	HÜR	78	14850±165
18.	854	Recent Lake Level			

* personal communications

purity benzene. These procedures are carried under 10^{-4} mm Hg pressure.

Equations for the related reactions are given below (14, 15).

$$\text{Sample} + H_3PO_4\ (oq) \longrightarrow CO_2\ (g)$$

$$2\ CO_2\ (g) + 10\ Li\ (liq) \longrightarrow Li_2C_2\ (s) + 4\ Li_2O(s)$$

$$Li_2C_2\ (s) + 2H_2O\ (liq) \longrightarrow C_2H_{2\ (g)} + 2\ LiOH\ (aq)$$

$$3C_2H_2\ (g) \xrightarrow[(60°C - 120°C)]{\text{(catalyst)}} C_6H_6\ (lig)$$

Better results are obtained for 100 grams samples which is equivalent to approximately 8 ml of benzene which is produced from these samples.

The benzene samples are kept in 20 ml special potassium-free glass sample bottles. Glass bottles with potassium give positive counting errors due to the B radiation emission of potassium -40 isotope. If the benzene samples are more than 8 ml, only 8ml parts are taken for counting. If the volume of samples are less than 8 ml, they are added up to 8 ml with ANALAR grade inactive benzene. Then the samples are prepared for counting by adding 2 ml scintillation coctail to each sample. The scintillation coctail is prepared by dissolving 2 g PPO and 0.5 g dimethyl POPOP in liter ANALAR grade toluene (16).

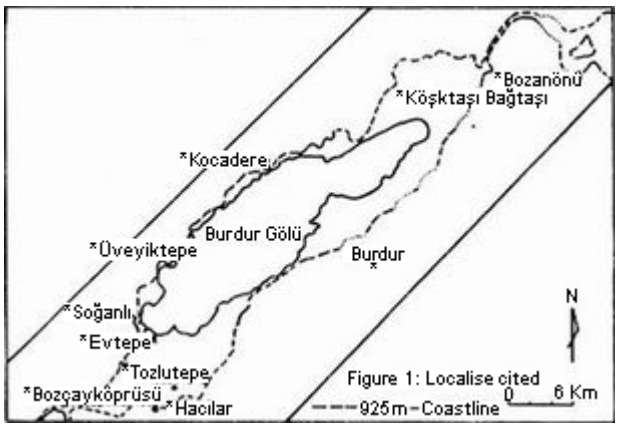

Figure 1: Sampling points are shown with * on the map.

Oxalic acid sample supplied by the National Bureau of Standards (USA) was used as the reference standard. This sample was converted to CO_2 by dry decomposition by heating and then converted to benzene. Background sample was prepared from ANALAR grade inactive benzene. Both standard and background samples were prepared for counting by the above mentioned procedure.

Prepared benzene samples, standards and background

samples were placed in the Packard 2001 Model Liquid Scintillation Spectrometer, and each was counted for 50 minutes and the whole counting procedure was reported for 20 times. The results were evaluated statistically and the standard deviations were calculated (17). The formula for the calculation of dating developed by W.S. Broecker and E.A. Olson (18), and the curve for determining isotopic selectivity developed by Craig (19, 20) were used for the calculations.

Present calibration curves go as old as 6000 B.C., therefore ages of the samples are given as the radiocarbon age.

RESULT AND DISCUSSION

Results of this study and three other related results are given in Table 1, and the map which shows the sampling points are marked on the map given in Figure 1.

Following interpretations may be deduced for the results of the samples from the same elevations in Table 1.

a. Lower Soganli and Kocadere

These are the oldest samples collected from 900-910 m levels according to the topographic map (Sample no's 11,12,13,14 and 6,7,8 in Table 1). The age of Roberts 2 sample (Sample no 11 in Table 1) is found as 28.000 years B.P. The ages of our samples from the same level are between 28,452 and 25,485. As it seen the results of two different laboratories are in good agreement. These ages represent the first half period of the würm pluvial transgression. This is the lowest level where dressensias are seen in thin layers.

b. Üveyik Tepe, Bagtasi and Soganli

These are the samples showing the highest levels of Pluvial Burdur Lake for würm period (Sample no's 1,2,3,4 in Table 1). Although these samples are taken from 4 different points of former shoreline at the level 930-935 metres, their ages (20958-23957 years B.P.) are very consistent and therefore important.

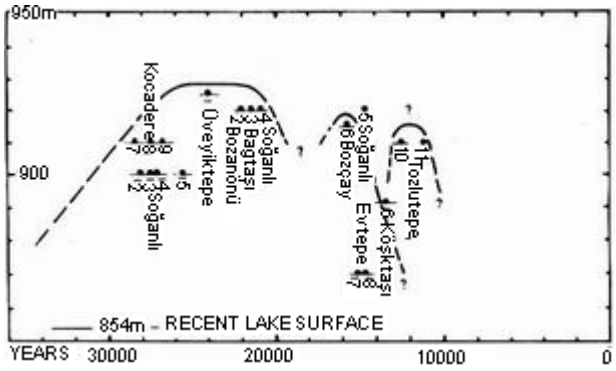

Figure 2: A preliminary lake level curve for the Pleistocene pulvial Burdur basin.

c. Hacilar-Bozçay Köprüsü

The age of the peat sample taken near the Bozçay bridge is found as 15,365 years B.P. (Sample no 5 in Table 1). The sample represents the muddy bottom of the lake. This may show one of the phases of the lake, the surface of which were lowering with oscillations during late Pluvial.

d. Tozlu Tepe

The ages (11000-12380 years B.P.) of the samples collected from the same place are consistent although they were analyzed two different laboratories (Sample no's 9 and 10 in Table 1).

e. Kösktasi

This sample of 13218 years B.P. age was collected at 893 m height (Sample no 15 in Table 1), but it should be younger compared with Tozlu Tepe samples.

f. Evtepe

Ages of samples collected from a former sandy beach are 14920 B.P. and 14850 B.P. (Sample no's 16 and 17 in Table 1). But, they should be the youngest samples due to their geomorphological situation and their appearance. As the geomorphological position of Tozlutepe and Kösktasi-Evtepe samples compared, there is a disaggreement between the ages of the localities. This may be caused by contamination during the later lake level ascillations or groundwater influences in Kösktasi and Evtepe localities. This disagreement should be revealed with the analysis of new samples from this region.

CONCLUSION

1. The quarternary history of the Burdur Lake Basin has had a rather complex evolution. There were many advances and withdrawal of the lake water level and these have left landform in the basin. More samples and dating is necessary to clarify this complex progress.

2. Present radiocarbon dating results has made posible the graph about the late würm pluvial period of the Burdur Lake surface in Figure 2. According to these data the lake water started to rise in the early pluvial about 35.000 years ago, and between 30.000-25.000 years has caused the accumulation of Transgressive deltaic sediment of Soganli and Kocadere. This transgression has reached the maximum level of 920-925 metres between the years 25.000-20.000, and has left a white colored marlylimy key horizon with aboundent dreissensia sheels all around the lake.

3. From 20.000 years onwards the regression period of the lake has started and lasted upto date with oscillations. The peat sample found near the Bozçay bridge which belongs to 15365 years B.P. may indicate regressional interval.

4. The Tozlu Tepe deposits north of Hacilar belongs to 10.000-12.000 years B.P. They indicate the slightly lower lake level of the latest stage of würm pluvial period.

5. According to their geomorphological position Köktasi and Evtepe deposits may represent two phases of major regression which point out the transfer from Pleistocene to Holocene. But their ages seem rather old as it is expected. This may be caused some later contamination and it should be revealed with the analysis of new samples.

REFERENCES

1. Louis, H. "Eiszeitliche Seen in Anotolien" Zeitschn. Gasell. f. Erdk. zu Berlin: 268-279, 1938.

2. Lahn, E. "Konya-Burdur Bölgesindeki Pliosen ve Dördüncü Zaman Tabakalari" Les depots Pliocenes et qaternaires de la region de Konya-Burdur. Revue de la Fac. des Sci. de 1'Univ. d'Istanbul (1946).

3. Bering, D. "Litostratigraphie, Tektogenese und seengeschicte der neogenen und quartaren intramontanen Bocken der Pisidischen Seenregion, Süd-Anototilen. "Kanozoikum und Braunkohlen der Türkei 5. Beih. Geol. Jb. 101. However, (1971).

4. Erol, O., "Konya, Tuzgölü, Burdur Havzalarindaki Pluviyal Göllerin Çekilme Safhalarinin Jeomorfolojik Delilleri" Geomorphological evidence of the recessional phases of the pluvial lakes in the Konya, Tuzgölü and Burdur basins in Anatolia (Summary) Cografya Arast. Derg. 3-4:13-52, Ankara, (1972).

5. Erol, O., "Quaternary Deposits of Burdur Lake basin. Congr. of Earth Sci. 50 the anniv. of Turkish Rep. 1973. Papers: 389-391. Ankara, (1975).

6. Erol, O., "The Palaeoecology of Some Neolithic Sites in South Central Anatolia. UISSP IXe congres. Res de Comm:363. Nice (1976).

7. Erol, O., "The Quarternary History of the Lake Basing of Central and Southern Anatolia. In BRICE W.C. (Ed.) The Environmental History of the Near and Middle East Since the Last Ice Age:111-139, Academic Press London, (1978).

8. Erol O. "Anadolu'da Kuaterner Pluvial ve Interpluvial Kosullar ve Özellikle Güney Icanadolu'da Son Buzul Cagindan Bugüne Kadar olan Cevresel Degisimler" Cografya Aras. Der. 9:15, Ankara (1980).

9. Erol O. "Pleyistosen Burdur Gölünün Pluviyal Kiyi izleri ve C14 Tarihlendirmelerinin Önemi. "The Pluvial Coastlines of the Pleistocene Burdur Lake and the Importance of C14 datings (Abstract). Arkeometri Ünitesi Bilimsel Toplanti Bildirileri IV 26-30.05.1983 Istanbul.: 3-13. Ankara, (1984).

10. Erol, O. "Quaternary Stratigraphy of Turkey" Symposium of Würm Stratigraphy. Abstract in: Abqrbeitsergaebnisse der Subkommission für Europsische Quartaerstratigraphie. Stratotypen des Würm-Glazials. Eiszeitalter und Gegenqart 35:185-206. Öhrngen, (1984).

11. Kazanci, N. Özkan, H.M., Alkan, A., Erol, O., "Burdur havzasi Pleyistosen deltaik kuvartz kumlarinin yüzey özellikleri: Elektron mikroskop uygulamasi. Grain surface features of Pleistocene deltaik quartz sands from Burdur Basin . Turkey : A SEM application (Abstract) "Doga 10.3:255-266, 1986.

12. Kazanci, N., Erol, O., "Sedimentary charesteristic of a Pleistocene fan delta complex from Burdur Basin, Turkey "Z.F. Geomorphalogie N.F. 31.3:261-275, 1987.

13. Evin, J., Ark Radiocarbon 22(2), 545-555, (1980).

14. Barker, H., "Radiocarbon Dating: Large-Scate Preparation of Acetylene From Organic Materials" Nature 172, 631 (1953).

15. Woakes, J.E., Kim, S.M., Stipp, J.J., "Chemical and Couting Advances in Liquid Scintillation Age Dating", 6th Int. Conf. On radiocarbon and Tritium Dating Proc. Washington: USAEC, 1968, Pages 68.

16. Birks, J.B., Solutes and Solvents for Liquid Scintillation Counting. Colnbroak, Bucks: Koh-Light Laboratories Ltd. U.K. (1972).

17. Otlet, R.L "Radiocarbon Dating" Eds. Berger, R., Suess, H.E. Univ. of Calif. Press. California, p. 256, 1979.

18. Broecker, W.S., Olson, E.A. "Lamont Radiocarbon Measurement VI "American J. Science, Radiocarbon Suplement, 1, 111 (1959).

19. Craig, H., "The Geochemistry of the Stable Carbon Isotops" Tellus, 3(1953).

20. Craig, H., "The Natural Distribution of Radiocarbon and the Exchange Time of Carbondioxide Between Atmosphere and Sea" Tellus, 9,1, (1957).

Correspondence:
Mehmet Kis
Hacettepe University
Dept. of Chemistry
Beytepe Kampüsü, Ankara
TURKIYE.