99. *Correlation between Palaeoclimatic Changes from Lake Biwa, Japan and Bogotá, Colombia in South America and Palaeotemperature Change from Equatorial Pacific*[*]

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Introduction. The investigation concerning the palaeovegetation and palaeoclimate changes in the ancient Lake Biwa basin throughout the Quaternary was started by analyses of a 200-meter core drilled in 1971, and has been continued by a 1400-meter core drilled in 1983 and 1984 from the view points of pollen analyses, palaeomagnetism, geochemistry, and geology. Recently, deep boreholes in such lands as California of U.S.A., the high plain of Colombia[10] and the Great Hungarian Plain,[16] and deep-sea cores such as Caribbean Sea[5] and Equatorial Pacific[17),18] which cover chronologically all the Quaternary were drilled at several localities over the world, and some analytical researches centering palaeoclimate changes based on palynology and oxygen isotope have been analysed on samples obtained from the cores.

Owing to these investigations, we have been assisted to prove easily a tentative global correlation concerning the palaeoclimate change during the Quaternary.[6),8),9] Consequently, the production of some significant findings is quite reasonable. The author[8] discussed comparative works between palaeoclimate change from Lake Biwa,[7),8] palaeotemperature changes in Caribbean Sea[5] and Equatorial Pacific,[17),18] environmental change by loess cycles and palaeontological evidence in Middle Europe,[13),14] and sea-level changes in Southern Kanto of Japan,[15] New Guinea[4] and Mediterranean.[3]

In this article, he tries to prove tentatively to correlate the palaeoclimate record from the ancient Lake Biwa basin with record such as the palaeovegetation and palaeoclimate history of Bogotá, Colombia,[10] and with the palaeotemperature record in the deep-sea Core V28–239 of Solomon Plateau, Equatorial Pacific[18] during the last 500,000 years.

Summarized description of the records. (1) Palaeovegetation and palaeoclimate records of the ancient Lake Biwa basin, Japan since nearly 500,000 years B.P. The Research Group of Palaeolimnology and Palaeoenvironment on Lake Biwa drilled to the depth of 200 meters below the bottom of nearly 65 meters of the present water level in Lake Biwa in 1971.[11] The present author succeeded to analyze palynologically samples from the 200-meter core and the upper 900 meters of the 1400-meter core for the purpose of analyses of the palaeovegetational and palaeoclimatic changes in and around the lake during the last about 3 Ma. years.

Judging from the author's investigation, during the glacial stages and/or

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stadials, the vegetation composed of some species which are similar to plants thriving in the recent Subalpine and Subpolar zones of Japan was distributed at the summit area and/or montane area around the lake. On the other hand, in the lowland area around the lake, the vegetation composed of some species being similar to plants which grow in the recent Cool Temperate zone was distributed. In the interglacials and/or interstadials, the palaeovegetation in the higher area was characterized mainly by the vegetation composed of some species which are similar to plants of the recent Cool Temperate and Temperate zones, and in the lowland area, the palaeovegetation was composed mainly of the broad-leaved deciduous and evergreen trees growing in the Warm Temperate zone. The palaeoclimatic change during the last 500,000 years in the ancient Lake Biwa basin is shown in Fig. 1.

(2) Palaeovegetation and palaeoclimate records of the high plain of Bogotá, Colombia, South America during the past 3.5 Ma. years. The study of the climatic history in the Quaternary of the Bogotá region, Colombia in South America was started by a study of vegetational change based on palynological analyses of terrestorial deposits obtained from two long cores drilled in the center of the high plain (about 2500 meters in above sea-level) of Bogotá region.[10),19)]

Judging from the 18 radiometric datings based on fission-track and K-Ar methods for about 100 volcanic ash layers intercalated in the cores, the age of the base of the long core is estimated to be nearly 3.5 Ma. years ago.

The palynological analyses of the long cores have provided a high resolution of vegetational and climatic records, of which the reconstructions are mainly based upon fluctuations of a forest line. On the basis of the pollen records from the Bogotá region, the long column is divided into 55 pollen zones, and into 27 major climatic cycles. The palaeoclimate history in the Bogotá region during the past about 500,000 years is to be summarized as shown in Fig. 1.

(3) Palaeotemperature curve based upon the oxygen isotopic record of the deep-sea Core V28–239 in Equatorial Pacific. Core V28–239 at Solomon Plateau in the Equatorial Pacific, Lat. 3° 15′N, Long. 159° 11′E[18)] preserves oxygen isotope and palaeomagnetic records for the Quaternary, and judging from the magnetic reversal scale, the core represents the last about 2 Ma. years. Shackleton and Opdyke[18)] recognized 23 stages within this deep-sea core, and the younger 16 stages of the core coincide with those taken from the Caribbean Sea.[5)] In the Core V28–239 record, odd-numbered stages are characterized by a small fraction of the light oxygen isotope (i.e. less continental ice sheet) and even-numbered stages by a greater fraction of the lighter oxygen isotope (more continental ice sheet). Additionally, in this core, a new characteristic feature is to be observed. This is the extremely drastic transition from glacial to interglacial, and these changes have been referred to as "termination".[2)]

The palaeotemperature curve based upon the oxygen isotopic record from the Equatorial Pacific is illustrated in Fig. 1.

Comparative observations of the palaeoclimate change in Lake Biwa, Japan, and those in Bogotá of South America and Equatorial Pacific. A vegetation, of course, has been generally affected by a climatic factor such as temperature and humidity. The palaeoclimatic changes, accordingly, have to be reconstructed by the vegetational changes estimated on the basis of the changes of composition of pollen grains and/or other plant fragments.

On the other hand, the deep-sea cores preserve detailed records of oxygen isotope resulting from the change of water temperature caused by ice volume in the

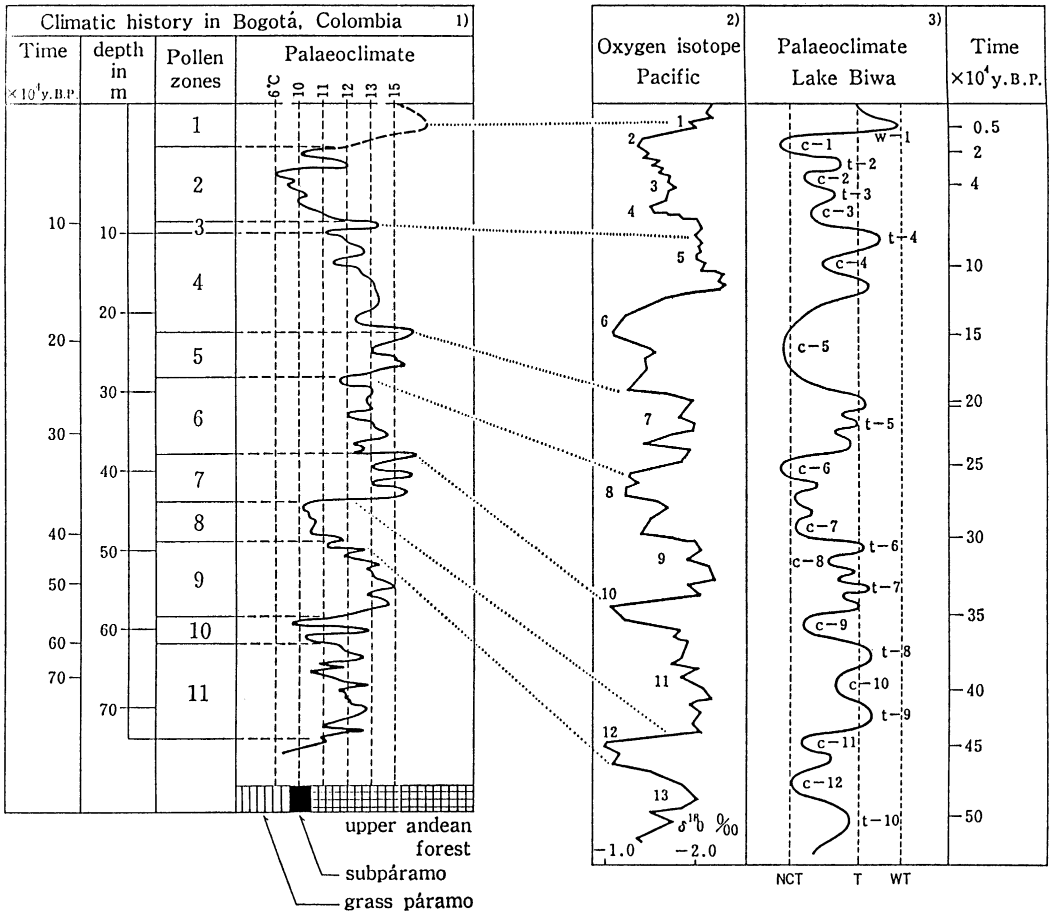

Fig. 1. Tentative comparison of the palaeoclimate from the ancient Lake Biwa basin and Bogotá of Colombia, and palaeotemperature from Equatorial Pacific. 1: Palaeoclimatic history in Bogotá.[10] 2: Oxygen isotope record from Equatorial Pacific.[18] 3: Palaeoclimate change from the ancient Lake Biwa basin.[7),8)] NCT, the northern part of the Cool Temperate zone; T, the Temperate zone; WT, the Warm Temperate zone.

ocean. The isotopic variations took place synchronously in all ocean water masses, and the mixing time to ocean water masses is of the order of about 1000 years.[1]

According to the recent data,[1),17)] a stage of the $\delta^{18}O$ curve is similar to that of an ice volume curve. Both the climatic change curves and the $\delta^{18}O$ variation curve, therefore, are generally related to the change of temperature in the past age. For this reason, it seems extremely reasonable from the view points of dating of core samples and physical causality, to compare the palaeoclimatic history based on the pollen records taken from Lake Biwa with those from Bogotá, and to discuss palaeotemperature history by the $\delta^{18}O$ records at the deep-sea in Equatorial Pacific. The palaeoclimatic curves from Lake Biwa and Bogotá were checked up by control points and $\delta^{18}O$ variations in a smoothed stack curve[12] normalized and plotted on the SPECMAP time scale in five deep-sea cores such as V28–238 (Equatorial Pacific), RC 11–120 (Indian Ocean), DSDP 502 (Middle America), V30–40 (Central Atlantic), and V22–174 (Southern Atlantic).

Through the present comparative researches pursued on the records in the last 500,000 years, all stages of the oxygen isotope record can be recognized in the palaeoclimate records derived from Lake Biwa and Bogotá data as illustrated in Fig. 1, and it may be concluded that there is a remarkably noticeable similarity in the three records.

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