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INTRODUCTION. A PROGRESS REPORT ON CHRONOLOGICAL AND ISOTOPIC STUDIES OF LAMINATED SEDIMENTS OF THE GOŚCIĄŻ LAKE WITH AN OUTLINE OF GEOPHYSICAL AND ASTROPHYSICAL IMPLICATIONS OF FUTURE STUDIES

This volume contains seven papers dealing with different problems of chronologic and isotopic studies performed in 1987 and 1988 by members of the Working Group of the Gościąż Lake Project. The Working Group was initiated by the Committee of Quaternary Research of the Polish Academy of Sciences immediately after discovery of laminated sediments of the Gościąż Lake, and acts under supervision of Professor Leszek Starkel, the President of Polish National INQUA Committee, with M. Ralska-Jasiewiczowa as the leader. Detailed programme of the research of the Working Group with the list of the scientific staff involved in this project was presented in paper by M. Ralska-Jasiewiczowa et al (1987).

The results presented in this volume were obtained on cores G0, G1 and G2. Although the climatical, hydrological and environmental interpretations presented by individual authors are very tentative, and sometimes controversial, the publication of this collection of papers seems important for several reasons. First, the papers included in this volume gather the results already obtained and should therefore facilitate the discussion on chronology of the sediment as well as on interpretation of recent chronologic and isotopic data. Moreover, the data included here seem to be useful for the specialists in different fields of natural sciences, who are engaged in studies of the Gościąż Lake.

CONTENT OF THIS VOLUME

In the first paper T. Goslar et al present a concise summary of the method used for establishing a floating varve chronology of the lower part of laminated sediment of the Gościąż Lake, and give the plot of the number of couplets versus depth in cores G1 and G2, which may be tentatively used for presentation of results of other studies in function of time. The chronology is floating, but, in spite of this, it is of crucial importance for studying rates of change of various parameters describing local or regional processes. Authors give also detailed discussion of weak points

and gaps of obtained chronology. The zero point of this chronology was tentatively chosen on basis of ^{14}C datings and comparisons with the number of varves counted in core G0 by K. Więckowski.

Second paper by T. Goslar investigates changes of the ratio of thickness of light (=summer) layer to total thickness of annual couplet of dark and light layers and presents comparison of this record with paleotemperature estimates from Tinkstade Trask, Gotland (Morner and Wallin, 1977) and Denmark Strait (Kellogg, 1984).

A. Pazdur and L. Starkel describe geochemical considerations based on the Broecker-Walton model and present reconstruction of changes of the water level of the Gościąż Lake, obtained from ^{14}C determinations in the carbonate fraction of lake marl. The results of model considerations are compared with other evidence resulting from studies of lakes, mires and rivers in Poland and adjacent areas, and some tentative explanations of observed discrepancies are given.

Next two papers by A. Walanus are of mathematical nature and are related to studies of periodicities occuring in the series of thicknesses of annual couplets. The method of running phase analysis, developed by A. Walanus, and described in the first paper, is then applied to searching for periodicities in series of laminae thicknesses, obtained by T. Goslar from measurements on cores G1 and G2. The results of cycle searching are presented in form of graphs covering interval of time of ca 10,000 years. Examples quoted by the author clearly show the presence of solar cycles (11 and 22-yr), as well as 35-yr and 200-yr cycles, suggested by results of other studies. The question of the occurence of other cyclical patterns is still open, and the author does not present interpretation of obtained results.

The paper by K. Różański et al presents detailed comparison of $\delta^{18}O$, $\delta^{13}C$ and varve thickness changes in two short segments from basal part of core G1, covering ca 200 and 300 years, respectively. Such detailed insight into results obtained using different methods in time scale of 10^2 yr seems to be highly important for future attempts of environmental interpretation of obtained data in the time scales of 10^3 and 10^4 yr. The paper is accompanied with short comment by L. Starkel, presenting first attempts of explanation of observed correlations.

The last paper dealing with studies of the Gościąż Lake sediment by J. Boryczka, B. Wicik and K. Więckowski contains another approach to analysis of cyclical changes of sedimentation rate in the lake. The method used by the authors is briefly described and the results are interpreted in terms of climatic changes during the Holocene. It should be pointed out that the methods used by A. Walanus and J. Boryczka et al are quite different, as well as the data used for analysis. The editor agrees with the opinion of the reviewer that both papers should be published in same volume, because, despite all differences, both papers contain clear description of the methods, initial data set used in analysis, and results obtained.

AN OUTLINE OF GEOPHYSICAL AND ASTROPHYSICAL IMPLICATIONS OF FUTURE STUDIES

Investigation of natural ^{14}C variations in the past, based on precisely dendrochronologically dated tree-ring samples of European oak and North American trees, were summarized by publication of the "Calibration Issue" of "Radiocarbon" (vol. 28, No. 2B, 1986). Calibration curves included in this issue cover about 12,000 yr. However, calibration data for early Holocene and Late Glacial are based on floating tree-ring chronologies with significant gaps. Moreover, the oldest part of calibration curve of Stuiver et al is tentative and is based on reassessed data obtained 20 year ago in studies of laminated sediments of the Lake of the Clouds and Swedish varves. These data are scarce and are subjected to relatively large errors, so they only indicate general trend of ^{14}C variations.

The results of chronologic studies of T. Goslar, presented in this volume in paper by T. Goslar et al, provide a firm foundation for studying natural ^{14}C variations in time interval beyond the range covered by ^{14}C measurements in tree-ring samples available from absolute European and American tree-ring chronologies. Application of the accelerator mass spectrometry (AMS) dating to macrofossils separated from precisely dated 10-yr segments of laminated sediment of the Gościąż Lake should provide important new data on changes of the ^{14}C level at the beginning of Holocene, and during significant part of the Late Glacial period. Detailed investigations of these changes in relation with various models describing carbon cycle in nature should become important contribution to studies of the Global Change Project.The information which may be derived from these studies includes astrophysical and geophysical processes which controll the production of ^{14}C isotope (eg, solar activity, geomagnetic field), as well as changes in the volume of main carbon reservoirs during the time of deglaciation and at the beginning of the Holocene time.

Another important source of information about astrophysical processes in the past is the sequence of varve thicknesses. Since the discovery of the laminated sequence at Pichi Richi Pass in S Australia, known as the Elatina Formation, by G. E. Williams, it was shown by studies of C. P. Sonett, R. N. Bracewell, and others, that changes in varve thicknesses provide unique information which can be interpreted in terms of solar activity variations. The methods developed for and applied to the analysis of the Elatina sequence should be in future applied also to the Gościąż Lake sequence. The main difficulty which may be expected is connected with significant noise present in the sequence of varve thicknesses of the Gościąż Lake (cf Fig. 1a,b in paper by A. Walanus, this volume). In all papers included in this volume the noise present in raw data was eliminated by taking running averages over 10 to 50 year intervals (cf papers by T. Goslar, A. Walanus, J. Boryczka et al.). Such a procedure causes smoothing of both the noise and the relevant cosmic signal, and the only way to overcome this difficulty seems analysis of many cores, and averaging of the individual annual increments obtained from different cores instead of time averaging.

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