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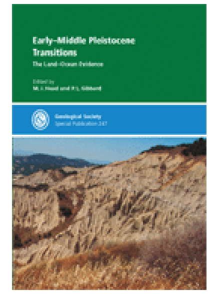
Early-Middle Pleistocene Transitions: The Land-Ocean Evidence, edited by M.H. Head & P.O. Gibbard, 2005. Geological Society of London Special Publication 251. The Geological Society Publishing House, Unit 7, Brassmill Enterprise Centre, Brassmill Lane, Bath BA1 3JN, UK. Hardback, 336 pages. Price GBP 85.00; USD 153.00 (members GBP 42.50; USD 77.00). ISBN 1-86239-181-5.



Recent developments in the accurate detection of the Early-Middle Pleistocene transition events were discussed during a one-day international conference at the University of Cambridge (U.K.) in April 2003. The book is a spin-off of this meeting. The transitions time zone is especially important as it marks a profound shift in the Earth's climate state. The 41-ka low-amplitude climate cycles, dominating the earlier part of the Pleistocene, gradually developed to a dominance of the 100-ka cycle characterizing the more recent cycles of glacial to interglacial shift scenario.

The major aim of this Special Publication is “to assess the biotic response to climatic and physical changes that characterized the climatic change events”, and to evaluate the biotic response to climate changes and the physical response of this transition on land and in the oceans. To take care of such a wide field of interest, the very nature of Quaternary climate change should be assessed first. This obviously starts with the evaluation of the Milankovitch cycles as well as the application of various paleoceanographical techniques using absolute dating methods like isotopes, microfossils and tephrochronostratigraphy. In this regard, the study of the organic geochemistry of marine deposits, the loess and soil depositional studies, and rapid changes recorded in the terrestrial vegetation history of a given area would be of help. On the other hand, by focusing on the migration patterns and evolution of various mammals, one might gain valuable knowledge on such drastic global events. Consequently such a collection of biota data would shed much new light on the origin of our present diverse biota on the Earth’s surface.

For a publication devoted to such a topic in Quaternary studies, the very first issue to deal with would be the definition and the boundary sets of this very specific episode in the Earth’s history, also known also as the “mid-Pleistocene revolution.” The editors have reviewed the development of the reported marine and terrestrial evidence for changes across this transition and recommend, based on practical grounds, the Matuyama-Brunhes Paleomagnetic Chron as the best overall criterion for establishing subseries boundaries.

It is therefore advantageous for researchers working on Pleistocene geological records to understand the current debates and consensus concerning the cause of the early-Middle Pleistocene. This will allow them to get a better understanding of their own climate-related field data, thus helping them to establish a more reliable climatic model.

Traditionally, the highly non-linear response of the global climate system is related to eccentricity. The development of an “eccentricity myth” was thus useful as it simplified our idea about the relationship between global climate and orbital forcing. The pronounced change in Earth-system response that became evident in paleoclimatic records does, however, not correspond with the frequency and amplitude during the Early-Middle Pleistocene transition. The characteristics of the three orbital parameters being responsible for long-term global climate changes, one might explain the important role of feedbacks mechanisms in the development of the glacial/interglacial cycles.

Focusing on the correlation between the terrestrial and marine environments, this volume of collected contributions brings together authors who discuss the evidence of the Early-Middle Pleistocene Transition era. This book incorporates the results of the most recent studies carried out in Europe, Russia, and New Zealand in relation to the land-ocean evidence in order to understand the manner of response of various terrestrial and marine environments to the cyclic events of this transitional interval in the Earth's history. For this purpose, several time and mechanism relationships have been identified in the various studied records of flora and fauna from Europe to India and from Arabia to Russia.

Maslin & Ridgwell review such mechanisms with the intention to assess the accuracy of the assumptions, and they conclude that the physical-climate feedbacks are less than sufficient when studying the timing and magnitude of the glacial/interglacial cycles. The authors then discuss the role of greenhouse gases. It is also discussed that the deglaciation turns out to be much quicker than the glaciation event, due to the natural instability of ice sheets. For the last deglaciation, this transition took approx. 4 ka. This includes the short Younger Dryas. The controls for such an event would be (1) increase in summer solar irradiation at 65°N, and (2) the rise of atmospheric CO_2 and CH_4 at a time of global warming that intensifies the melting process of the large continental ice sheets. This phenomenon would initiate a sea-level rise that could extremely rapidlyo undercut the still existing ice sheets.

In reviewing different hypotheses to explain the critical non-linear transition events, Maslin & Ridgwell list the following: (a) a critical size of the Northern hemisphere ice sheets, (b) a global cooling trend, (c) changes in the global carbon cycle and of the atmospheric CO_2 concentration, (d) the influence of the Greenland-Scotland submarine ridge, and (e) the role of intermediate ocean circulation and gas hydrates. They finally demonstrate why eccentricity cannot be the direct forcing of the 100 ka glacial/interglacial cycles, and that precession rather than eccentricity seems to be critical. They conclude that the Middle Pleistocene Transition event is not the introduction of a strong non-linear amplification of eccentricity, but the achievement of a system state that allows ice sheets to survive during weak precession insolation maxima, and to grow large enough during obliquity ice-volume maxima to generate a strong positive CO_2 feedback.

Schefuss, Jansen & Sinninghe Damsté report on the lipid biomarker accumulation rates and bulk organic geochemical records, using principal-component and spectral analyses to evaluate the main forcing factors of phytoplankton productivity and lipid-transport changes in the Angola Basin in the eastern tropical Atlantic. They conclude that the relative lipid contributions indicate a significant change in the primary-producing ecosystem. Before the growth of the mean global ice volume, enhanced siliceous marine production was mainly controlled by monsoonal variations in river runoff, and oceanic upwelling was forced by variations in trade-wind zonality. Both precession-driven processes were suppressed by the enlarged global ice mass after the beginning of the mid-Pleistocene transition. The continental aridity is reflected by compound-specific $\delta^{13}O$ of the plant-wax lipid. A strong increase in eolian transport of terrigenous plant waxes as well as wind-driven coastal and oceanic upwelling with the onset of 100 ka cyclicity is evidenced. From this time onwards, aridification of the continent and strengthening of the trade winds caused profound environmental changes in the tropical realm.

John Schneider et al. describe a detailed investigation of the response of the tropical African and East Atlantic climate to orbital forcing over the last 1.7 Ma. Using the total organic-carbon mass accumulation rate and Fe intensities, they conclude that the eccentricity modulation of the low-latitude insolation directly influenced the equatorial African monsoon system and probably the weathering conditions on land.

Hayward et al. studied the benthic foraminiferal faunas of three bathyal successions in the SW Pacific and conclude that strong glacial/interglacial fluctuations are recognizable as the time-spans when high interglacial nutrient supply was associated with lower oxygen levels.

The distribution of some calcareous nannofossils in the Mediterranean Sea and Atlantic Ocean were correlated with magnetostratigraphy and oxygen-isotope stratigraphy in a study by

Reale & Monechi. They conclude that this fossil study made possible a correlation to the transition between Marine Isotope Stages 25 and 24, and it also confirmed the diachronous character of this event between low and mid to high latitudes.

The deep circulation in the western subtropical Atlantic during the Early-Middle Pleistocene was studied by Ferretti et al., who show that it is possible to use the benthic-carbon-isotope signal as a water-mass tracer. This study suggests a scenario in which the two different source components of deep water can undergo dramatic changes in their circulation regime through time, which should be taken into consideration. This is especially true when evaluating the role of the thermohaline circulation in global climatic change.

The special volume includes three scientific reports on the pollen studies of the North and Central Mediterranean, as well as one from New Zealand. All deal with the differentiation of pollen evidence in space and time. The articles view the pollen records in a cyclostratigraphy perspective to correlate the Mediterranean/New Zealandian flora with oxygen isotopes.

The editors have provided a comprehensive overview of the contributions presented in this special volume. Dividing the contributions into three categories, the editors managed to classify eighteen contributions. In the marine realm, there are six contributions. In the terrestrial realm three contributions deal with pollen studies and seven studies deal with the mammalian fauna. The only paper included in this special issue dealing with clastic sedimentology is a review paper discussing the distribution of loess deposits in various parts of Russia.

This special publication is a very valuable resource for the Quaternary geology of the specific climate event in the Early-Middle Pleistocene. The editors define the publication as a collection of "most of the presentations at the conference as well as several solicited contributions to provide the balanced coverage of the topic." There is, however, more emphasis on pollen and fauna studies than other aspects of the Quaternary sciences that would have also have provided interesting indformation about the distribution and development of biota during the Pleistocene. It is unfortunate that other disciplines get hardly any attention. The clastic sedimentology of Quaternary deposits is one of the issues that are hardly dealt with: just one out of the eighteen contributions is devoted to clastic sediments; this is the review paper by Dodonov in which the author presents a review on the loess record in the northern Eurasia as investigated mainly prior to 1990. I admire the taste of the editors for selecting a photo of a clastic sedimentary outcrop as the cover illustration of this book. At the same time, there are, in my opinion, many more clastic sedimentary records that deserve a contribution in such a comprehensive publication; however fantastic the cover photo is, it is insufficient compensation for the lack of contributions in clastic sedimentology.

It is well-known that the Special Publications book series is the flagship of the Geological Society. The books of this series are, according to the publisher “renowned throughout the global geoscience community for their high quality of science and production. They represent state of the art treatments of their subject matter and cover all branches of the Earth sciences, both established and emerging.” While this book certainly meets the above-mentioned criteria and is, indeed, of high quality, one would expect a more expanded perspective in dealing with research on Quaternary climate-change events.

As a matter of fact, the outstanding characteristic features of the formerly glaciated areas were among the very first issues that were recognized by the 19th century geologists. They, as well as their successors, looked at the streamlined and polished landscapes of these glaciated regions, and so Quaternary science was born. In order to study modern physical processes and deposits of Quaternary glacial and arid landscapes, and use this information to interpret paleoenvironments, the previous generation of geologists (Flint, 1947; Sugden, 1976, 1978) started to discuss the necessity of an evaluation of the glacial sediments of the Laurentide Ice Sheet. The importance of the recognition of the morphology of glacial landscapes resulting from both the Laurentide and the Scandinavian ice sheets was then highlighted (Kleman, 1994). This perspective resulted later in a new approach to Quaternary research by focusing on the sediments as a major factor in the formation of various basins suitable for evolution and further development of flora and fauna in the course of time.

While until 1990 the loess studies were almost the “only” contribution of clastic sedimentology to chronostratigraphy and climate change studies, further studies in Sweden developed a new approach with special focus on the application of clastic sedimentological studies in climate change studies with, among others, Gail Ashley, Tom van Loon, and James T. Syvitski in the frontline (Lundqvist et al., 1998). The studies have improved our understanding of the distribution of biota in the glaciated areas following the climate-change events. As a matter of fact, the possibilities of such morphological studies in combination with biostratigraphic investigations are yet to be explored. One might argue that this perspective is a paradigm shift in climate studies, which provides a deeper insight into the physical processes involving the geological events. This, however, does not necessarily mean that the old paradigm is useless.

This Special Publication might, in my opinion, have profited from a short review contribution presenting the very essence of the massive investigations done in the various aspects of exploration geology applied in petroleum industry; this would have substantially contributed to the applicability of this publication. It would also have expanded the target reader group that is interested in the Early-Middle Pleistocene transition events.

I have enjoyed reading this Special Publication. Once I picked it up, I found it hard to put down until I had gone through several chapters. The publication is suitable for researchers and interested persons with a fair background in the Quaternary sciences, and I do warmly recommend this fine reading to my colleagues in academia.

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