Early Paleogene Warm Climates and Biosphere Dynamics: Meeting in Göteborg makes progress in deciphering the dynamics of past greenhouse worlds

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The meeting on Early Paleogene Warm Climates and Biosphere Dynamics was held June 9 - 13, 1999, in Göteborg, Sweden, and was organized and hosted by B. Schmitz. Schmitz was assisted by organizing committee members M.-P. Aubry and J. Zachos. This meeting was the fourth such gathering in recent years and was the largest and most successful meeting yet. There were 120 scientists in attendance from 21 countries. The largest group came from the United States; other well-represented countries were the United Kingdom, Russia, and Germany. The meeting, aimed at a multifaceted understanding of the early Paleogene, had a strong interdisciplinary character. Over 4 days, participants presented scientific research in oral and poster sessions. The meeting ended with a 1-day field trip to the early Paleogene deposits of northern Denmark.

The early Paleogene may contain unique and critical records of greenhouse world conditions that could provide insights into other past and future greenhouse worlds. Results presented at this meeting reinforced this concept and showcased many exciting scientific developments. Great breadth and depth of information about conditions, theories, and predictions of Paleogene climatic and biotic systems were presented. New and important data were presented for the global oceans of the Paleogene as well as for continental sites located in Europe, Asia, Africa, the Middle East, North America, New Zealand, and Australia. Modeling results were used to predict past oceanic and terrestrial conditions and processes that may have been critical in the Paleogene world.

Specific sessions focused on topics including the Paleocene-Eocene transition, the vertebrate record, the paleobotanical record, clay minerals and climate, geochemical records, oceanic upwelling and productivity, and regional geologic and paleoclimatic studies. Many presentations dealt with different aspects of the late Paleocene thermal maximum (LPTM) event, the short-term (~100 kyr) dramatic warming of the high latitudes associated with important faunal turnovers both on land and in the oceans. Some of the most exciting work presented at this meeting included the boron isotopic data from P. Pearson and M. Palmer that indicated possible "super greenhouse" times in the early Paleogene, the suggestion by E. Thomas and J. Zachos that there may have been several "hyperthermal" events during the early Paleogene, and the hypothesis by D. Rea et al. that the early Paleogene Intertropical Convergence Zone may have been located more than 20ø latitude north of the equator.

Of broad interest were the discussions and predictions of large-scale causes and consequences of climate change during the early Paleogene. P. Markwick et al. compared the results of general circulation models and fossil crocodilian distributions for the early Eocene and stressed the need to calibrate models with geologic proxy data. M. Huber and L. Sloan presented modeling results that predicted substantial changes in terrestrial climate conditions, upwelling patterns, and ocean currents for LPTM versus Paleocene conditions.

Many presentations addressed new or refined proxy data reconstructions of the early Paleogene climate. For example, H. Fricke presented latitudinal gradients in temperature over North America from stable isotopic measurements of vertebrate tooth enamel and fish scales. F. Andreason and B. Schmitz showed high-resolution intra-annual temperature and humidity reconstructions based on stable isotopic measurements along the shell spiral of aragonitic freshwater and marine gastropods. L. Golovneva used fossil leaf foliar physiognomy to show that early Eocene floras at Spitsbergen were warm temperate in character and that the mean annual temperature range in the region was 12ø - 18øC. Other paleobotanical reconstructions indicating a much warmer world than today were presented for the western interior of North America by S. Wing, for Australia by D. Greenwood, for southern England by M. Collinson, and for central America by A. Graham. Several presentations addressed the response of various vertebrate groups, including turtles and primates, to warm climates and to changes in climate through the Paleogene. H. Lutz and F.-O. Neuffer reported on the middle Eocene Eckfeld Maar layer, a remarkably well preserved fossil site from Germany. This new locality will provide an important window into the early Paleogene climate and biosphere.

Numerous talks discussing the LPTM event presented many new perspectives on this greenhouse climate interval. E. Crouch et al. showed that in connection with the LPTM event, Apectodinium dinoflagellates bloomed in marine environments worldwide. Y. Gavriloiv reported on the widespread formation of organich-rich anoxic layers in Tethyan environments during the LPTM event and hypothesized that a sea level drop and seaward flux of terrestrial nutrients triggered sapropel formation. R. Norris et al. presented an astronomically tuned chronology for the LPTM event indicating that it persisted for

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This timing was supported by S. Wing’s terrestrial floral data. On the basis of detailed analyses of the δ13C record at Ocean Drilling Program (ODP) Sites 1051 and 1050, Norris and coauthors suggested that methane or another source of 13C was introduced into the biosphere in a series of two or three events spread over ~20-30 kyr. A topic of discussion at the meeting was the origin of increased kaolinite deposition during the LPTM event. In three separate talks, by T. Adatte et al., P. Gawenda et al., and T. Gibson et al., it was hypothesized that the kaolinite increase reflects increased humidity during the LPTM event. In contrast, M. Thiry and C. Dupuis argued that the lower Sparnacian kaolinites in France formed in the humid Mesozoic and were reworked in semiarid environments during the Sparnacian. P. Gingerich and S. Lucas, in two separate talks, discussed an important faunal turnover at or close to the LPTM event that resulted in the evolution of a mammalian fauna similar to modern fauna. M.-P. Aubry described a unique calcareous nannofossil assemblage that is associated with the LPTM in many parts of the world. She, Lucas, and Gingerich raised the intriguing point that the origins of modern nannoplankton and mammals are associated with the LPTM, not the Cretaceous/Paleogene boundary as might be expected. Y. Gladenkov discussed the extreme high-latitude warming associated with the LPTM and showed that tropical molluscs reached as far north as Kamchatka during this event. J. Zachos and J. Dickens presented mass balance and biosphere feedback model results that indicate a major input of methane from gas hydrates to the ocean-atmosphere system during the LPTM event. Several of the model-predicted responses to such a gas release are apparent in existing sediment records. These and many other presentations indicate that the LPTM event may provide important information for predicting and understanding processes associated with global warming.

A postmeeting field trip to Denmark was led by C. Hellmann-Clausen and E. Thomsen. Participants studied the impressive exposure of the late Paleocene-early Eocene Fur Formation ash layers, remains of possibly the most dramatic episode of basaltic explosive volcanism in Earth history. Other sites studied included the famous Cretaceous/Paleogene boundary outcrop at Nye Kjøv and the Hinge clay quarry with an exposure of the laminated and anoxic basal Øst Formation that represents the LPTM event in the North Sea.

From both a climatic and biologic perspective this is an exciting time to be working on a topic as dynamic as early Paleogene history. Meeting presentations and discussions revealed that the early Paleogene was a time of major biotic and climatic changes far more complex than previously realized. We anticipate that the next decade will see great progress in documenting and understanding the conditions of the early Paleogene. We further expect that researchers will produce more information and details about climatic and biotic change through the Paleogene and that we will see increased integration of marine and terrestrial data focused on these problems. The results of this effort will provide scientists with a greater understanding of the global and regional causes and consequences of Paleogene climate change and give us greater insights into some fascinating past greenhouse worlds.

The success of this meeting stimulated planning efforts for a follow-up meeting to be held tentatively in the Bighorn Basin, Wyoming, in the summer of 2001. S. Wing and others have taken the lead in planning this meeting. The organizing committee for the Göteborg meeting wish them success.

Extended abstracts of work presented at the Göteborg meeting will be published this coming winter in the journal GFF published by the Geological Society of Sweden. The organizers and participants of the meeting are grateful for the financial support and sponsorship of the Swedish Natural Science Research Council, Wenner-Gren Center Foundations, S. Lindqvist at Göteborg University, the Swedish Institute, and the International Subcommission on Paleogene Stratigraphy.

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