Dust Indicators and Records of Terrestrial and Marine Paleoenvironments

Mineral dust aerosols play an important role in the global climate system, by mediating physical and biogeochemical exchanges among the atmosphere, land and ocean. Atmospheric dust can have a profound effect on the earth system by affecting the radiative forcing of the atmosphere, through chemical reactions with other atmospheric constituents, and through its impact as a source of micronutrients to marine and terrestrial ecosystems. As the net effect of these processes is still unknown, climate modeling studies are underway to assess the overall magnitude and direction of the forcing effect of dust on the current climate.

Records of dust from ice cores, marine sediments and loess deposits clearly demonstrate that throughout the Quaternary, glacial periods were considerably dustier than interglacial periods. The high concentrations of atmospheric dust during the last glacial period make it an excellent test of our ability to model the fluxes, concentrations, and interactive effects of dust in the atmosphere. Observational datasets are crucial for verifying that the simulated magnitudes and distribution of dust resemble reality. Validation datasets help to quantify changes in potential dust source areas (e.g. using maps of vegetation and loess accumulation), as well as identifying the magnitude and extent of dust during past climate periods.

A preliminary attempt to compile dust fluxes from ice cores and marine sediments for the Last Glacial Maximum was initiated as part of the Mineral Aerosols on Glacial-Interglacial Cycles (MAGIC) project (Figure 1 in 'Loessfest' workshop report, facing page), for comparison with model simulations of the dust cycle for the last glacial and current climates. There is a need to improve this dataset and extend it to also include terrestrial data from the last 30,000 years, in order to document the complete glacial, deglacial, interglacial sequence. In addition to eolian fluxes, this database should contain the background data necessary to interpret the flux information, as well as additional metadata. In addition to its utility for model validation, this database could provide a useful repository of dust data, serving a variety of purposes for earth scientists.

The Dust Indicators and Records from Terrestrial and Marine Paleoenvironments (DIRTMAP) database has been established to serve both the earth science and modeling communities. This initiative was recently named a highest priority item for the IGBP/GAIM Paleo Trace Gas and Mineral Aerosol Challenge (TRACES), endorsed by IGBP/PAGES Paleo Mapping Project (PMAP), and by International Geological Correlation Programme (IGCP) #413. It has been recognized as an important formal activity of the INQUA Loess Commission, over the next two inter-Congress periods (1999–2007). We are enlisting the help of the international community to produce this new database. As "Phase 1" of the data collection activities, we have established an interactive web form, through which members of the loess community can contribute information about their field sites to a global inventory of analyzed loess deposits (see the "Fink Link" at *http://www.bgc-jena.mpg.de/bgc_prentice/start1.html*).

As "Phase 2," the DIRTMAP database will target data from 0 to 30,000 years BP, containing sediment age models and accumulation rates, bulk densities, mineralogical and provenance tracer data, grain size information, and chronological data (e.g. radiocarbon dates, luminescence dates, stratigraphic correlations, etc.). Any data included in the database will have the additional documentation that is required for interpretation. DIRTMAP is intended be a public access database. Participants will have access to the data during the developmental phase. Scientists interested in contributing to this effort or in obtaining more information can contact Karen Kohfeld, the DIRTMAP Database coordinator, at the address below.

Karen E. Kohfeld
Max Planck Insitute for Biogeochemistry
Jena, Germany
dirtmap@bgc-jena.mpg.de

DIRTMAP Scientific Advisory Committee
Ed Derbyshire (London, UK)
Sandy P. Harrison (Jena, Germany)
Dan Muhs (Denver, USA)
Ann Wintle (Aberystwyth, UK)
Liping Zhou (Beijing, China)

DIRTMAP

WORKSHOP REPORTS

Loessfest'99

Bonn, Germany 26 March – 1 April 1999

"Loessfest'99", the INQUA/IGCP Spring Dust Festival was an international conference sub-titled "loess: characterization, stratigraphy, climate and societal significance". The initiative for this meeting came jointly from IGCP Project #413 on 'Understanding Future Dryland Changes from Past Dynamics' and the Loess Commission of INQUA. Its aims were to review the current state and future directions of loess research. "Loessfest'99" marked both the 175th anniversary of the first description of the Rhineland loess at the *locus classicus et typicus* at Haarlass, near Heidelberg by Karl Caesar von Leonhard, and the 30th anniversary of the INQUA Loess Commission. It came just five years after the 'stock-taking' meeting on *Windblown Sediments in the Quaternary Record* held in Royal Holloway (University of London, UK) under the aegis of both IGCP and INQUA, and the NATO sponsored gathering in Loughborough UK on *Genesis and Properties of Collapsible Soils.*

Valued support was provided by the Deutsche Forschungsgemeinschaft (DFG), the Gesellschaft für Technische Zusammenarbeit (GTZ), SAS, the Fachbuchhandlung Sven von Loga, Eijkelkamp Agriresearch Equipment, the Centre for Quaternary Research, University of London, and Elsevier Science Limited, Oxford, UK, as well as from IGCP and INQUA.

In Bonn, a total of 88 papers by just under 100 participants were presented as keynote reviews, oral presentations and poster papers, and included a special evening lecture by W. von Koenigswald on *Climatic changes recorded by the Quaternary fauna in the Rhine area*. Scientists came from 16 countries on five continents.

Appropriately enough, Loessfest'99 began with keynote reviews on, first,

the question of the origins of loess particles and, second, on 175 years of loess research in Germany. The broad spectrum of geotechnical problems associated with loess as a collapsing soil were considered in a series of papers, following a keynote address on *Loess as a Geohazard*. Subsequent sessions went further into the origins of loessic dust, including data from a number of contrasting laboratory experiments. Further sessions, each led by at least one keynote review, included the latest work on paleosols in loess, the use of loess to infer the dynamics of the paleomonsoons and related atmospheric systems, and the dating of loess-paleosol sequences. More than a quarter of the papers focused on the stratigraphical record in loess-paleosol sequences, including problems associated with their dating, as well as the increasing potential of loess biostratigraphy, notably in the higher resolution use of molluscan faunas.

New data were presented from most continents, i.e. Europe, South and North America, Africa and Asia (including Siberia). Some serious inadequacies in the dating of these deposits were highlighted. Until recently, variation in climate proxy parameters such as magnetic properties, grain size and soil typology has been used for climate reconstruction. Chronometric attribution of these has been based on correlation with isotopic records. Some of these results led to a call for caution in such exercises in the absence of a sound geological framework. There was very useful debate concerning the fact that the Brunhes-Matuyama boundary invariably occurs in oxygen isotopic stage L9 in deep ocean sediments (representing a warmer epoch) but is found in loess layer L8 (associated with a cold period) in the Chinese loess. An explanation of this in terms of delayed remanence acquisition in loess with time lags (between particle sedimentation and the '*locking in*' of the magnetic signal) ranging from a few thousand to perhaps as much as 35,000 years was discussed, and gave rise to considerable debate. Such time lags, although perfectly plausible, add further difficulties to high-resolution paleoclimatic reconstruction. The likelihood of site dependence to varying degrees should lead to further initiatives in the understanding and quantification of these lags.

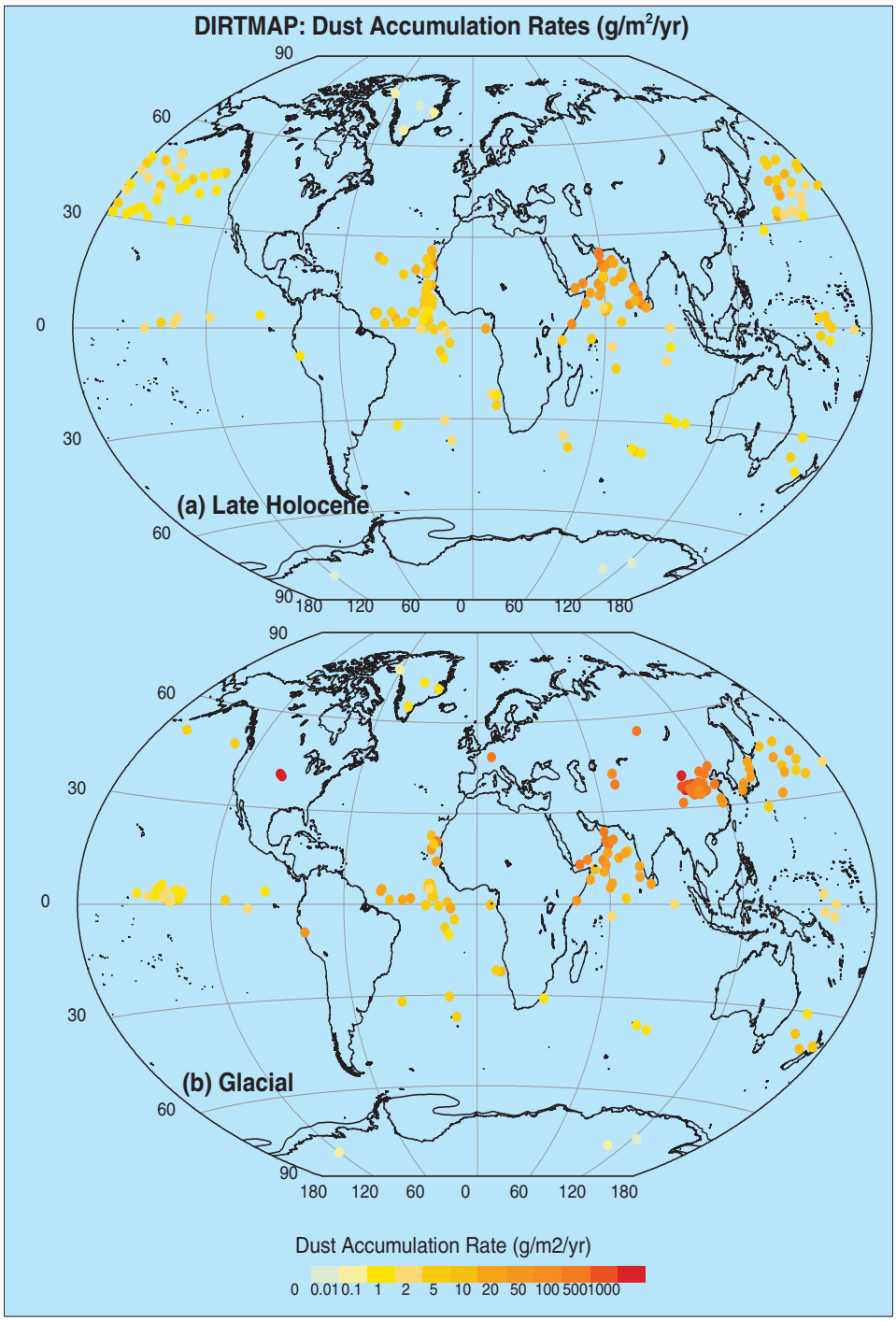

Figure 1: First approximation global map of dust accumulation rates for the modern era and the Last Glacial Maximum, presented at the "Loessfest'99" meeting by Karen E. Kohfeld.

A considerable amount of new data on absolute dating using luminescence was also presented for several new sites. Excellent concordance between loess and AMS radiocarbon ages on organic matter was noted, but it is also evident that it poses problems in explaining a consistent underestimation of radiocarbon ages from similar loess-paleosol sequences. Even so, and despite the problem of age underestimation in luminescence dating, the large volume of luminescence ages clearly suggests to some workers that the *windows of opportunity* for loess accumulation occur postglacially and for relatively short periods of time. Thus there is now a need to reconcile the somewhat divergent inferences provided by luminescence ages and those provided by magnetic/sedimentological studies. This also points to the need for great care in the identification of high-resolution phenomena, such as Heinrich events, in loess sequences. It was proposed that

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Loessfest, continued from previous page

we should recognize a minimum number of prerequisites when using such records. Several authors cautioned against 'wiggle matching' without sufficient background data on and from the site, the selected proxy itself, and on the time series. In this context, a convincing case was made for the use of paleopedology and soil micromorphology in both climatic reconstruction and as a means of ensuring the reliability of any chronology. Several papers showed how these techniques make it possible to delineate a stage by stage record of loess sedimentation and its frequently complex patters of diagenesis, information that is crucial for reliable dating. Yet other work in this section showed how good quality optical dating has successfully delineated the impact human occupation has had upon the loess over the past 1000 years.

There were several studies on the characterization of modern dust fall events and their climatological implications. The subtleties involved in establishing a link between present-day atmospheric dust events and climate, on the one hand, and the interpretation of the Pleistocene record of dust accretion and paleoclimate, on the other, were also explored. This discussion was a precursor to several keynote talks, several papers and a plenary discussion designed to involve the loess community in an initiative to establish a terrestrial eolian sediment data-base for the Last Glacial Maximum. The meeting strongly endorsed this DIRTMAP project (see page 6), which will involve the formal participation of both the INQUA Loess Commission and IGCP 413, as a means of gathering, synthesizing and collating data on dust, including loess, in a form capable of testing and improving global models of aeolian dust accumulation (Figure 1). Dr. Karen E. Kohfeld (Database Coordinator) has already set up a DIRTMAP website at *http://www.bgc-jena.mpg.de/*.

Taken over all, the meeting re-emphasized the value that the extended and semi-continuous nature of loess-paleosol sequences offers as the basis for terrestrial stratigraphical studies of longer-term Quaternary paleoclimates. At the same time, it brought out a number of *caveats* on the use (or abuse) of climatic proxies and the land-sea correlations based on them. A strong message that emerged is that considerably improved understanding of the underlying physics underpinning every climatic proxy's phase relationship with climatic parameters is needed.

Selected peer-reviewed papers presented at "Loessfest'99" will be published as special issues of two international scientific serials: *Earth Science Reviews* (keynote reviews) and *Quaternary International*. The aim is to publish both by the summer of 2000.

"Loessfest'99" was a rich cocktail of scientific data and ideas on almost the whole spectrum of global loess research. The initiatives noted above, including the major international effort required to maximize the value of the DIRTMAP project, are some measure of the progress recorded by "Loessfest'99" and its potential as a springboard for further advances in loess research.

Edward Derbyshire
Centre for Quaternary Research
Royal Holloway, University of London, UK
100666.1577@compuserve.com

Ashok K. Singhvi
Earth Sciences Division
Physical Research Laboratory, Ahmedabad, India
singhvi@prl.ernet.in

LUCC–PAGES–DIS

Barcelona, Spain, 17–20 November, 1998

Data strategies for Research on Historical Dynamics of Land Use

The outcomes from a joint LUCC–PAGES–DIS working meeting on Historical Land Use/Land Cover Change and two Working Group 'break-out' sessions held during the LUCC–DIS Data meeting are summarised on the PAGES Website at *http://www.pages.unibe.ch/activities/focus3/forum3.html*. The proposals outlined there are also consistent with the outcome of planning sessions devoted to developing the "terrestrial" aspects of PAGES Focus 3 (Human Interactions in Past Environmental Changes), and strengthening the contribution of PAGES–LUCC interactions. One of the most concrete outcomes has been the establishment of an initiative to reconstruct land cover for 300 years ago – "BIOME 300". Although, in many parts of the world, major land cover changes predated this, the period since AD 1700 has seen the greatest human-induced transformations on a global scale. This will involve establishing, from all the sources available ranging from cartographic and documentary to palynological, the best possible empirical basis for reconstructing land cover around that time. It is seen as a first step towards a longer term program on land use/cover change designed to trace the major transformations in each region right up to the stage where documentary, statistical and satellite-derived data provide an increasingly secure basis for land cover mapping. Colleagues interested in contributing to BIOME 300 should, in the first instance, contact Frank Oldfield.

Frank Oldfield
PAGES IPO, Bern, Switzerland
oldfield@pages.unibe.ch

IGBP Congress

Shonan Village, Japan, 6–13 May, 1999

A report covering "PAGES at the IGBP Congress" will appear in the next IGBP Newsletter.

At the occasion of a PAGES social gathering during the Congress, Claude Lorius presented a poem about PAGES and human dimensions:

Il faut me pardonner
Mais pour mieux m'exprimer
Je dois français parler

Ce que je voudrais dire
Ne prête pas à sourire
La terre pourrait mourir

Les leçons du passé
Que PAGES veut étudier
Disent qu'il faut espérer

L'homme a su s'adapter
Et il saura trouver
Comment s'organiser

Notre communauté
(C'est de PAGES qu'il s'agit)
Ell a bien su trouver
Les thèmes qu'il faut traiter

Il y a l'homme aussi
Il se sent bien ici
Dans ce cercle d'amis

Claude Lorius
Laboratoire de Glaciologie & Géophysique de l'Environnement, Saint Martin d'Hères, France
lorius@glaciog.grenet.fr