MEETINGS

Environmental Processes of East Eurasia: Past, Present, and Future

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The thick loess deposits of China have provided rich and detailed insights into past environmental conditions in East Asia, enabling links to be made between climatic changes in continental Asia and marine sedimentary records through the Quaternary period. Until recently, these eolian deposits were the primary paleoenvironmental archives from the region, but in the last decade or so great strides have been made in broadening the basis of paleoenvironmental reconstruction in the region. This has involved new analytical approaches to the study of loess, as well as an explosion of research into other natural archives—lake sediments, peat, ice, speleothems, and tree rings.

To review these developments, and to identify new opportunities for future research, a recent symposium on Environmental Processes of East Eurasia: Past, Present and Future brought together over 50 participants from eight countries.

Long sedimentary records from Lake Baikal [*Kashiwaya*, 2003] and new discoveries of pre-Quaternary loess/soil sequences reveal the importance of the uplift of the Tibetan Plateau for understanding long-term changes in climate. Loess has accumulated intermittently in northwestern China for the past 22 Ma, indicating the existence of arid conditions in the Asian interior since that time [*Guo et al.*, 2002]. Soils, which separate loess units, register periods when monsoon rains extended farther inland. Loess accumulation rates have increased over time, especially after ~3.6 Ma B.P., as a consequence of the increase in elevation of the Tibetan Plateau which enhanced aridity in the continental interior. Studies of fluvial terraces in the northeastern Tibetan Plateau provide additional insight, suggesting that the most significant episodes of uplift took place at ~14, 11, 1.2, and 0.15 Ma ago.

Global circulation models of the effects of Tibetan Plateau uplift by *Abe et al.* [2003] demonstrate the importance of these changes, not only for airflow to the continental interior, but also for the circulation elsewhere. As the Tibetan Plateau became higher, it led to a westward shift in the zone of maximum Pacific sea surface temperatures and intensification of the Aleutian Low. In addition, as the continental interior became more arid, dust flux from the continents to the Pacific Ocean increased. This may have increased biological productivity in the North Pacific, and may have contributed (by up to 9 ppmv) to the reduction in atmospheric CO_2 during glacial periods.

Sediments recovered from Lake Baikal extend back ~8 Ma. They reveal long-term cooling, with major cold episodes from 2.82–2.48 Ma and 1.75–1.45 Ma B.P., and glaciation of the Lake Baikal basin around 2.67 Ma B.P. when glaciers extended into the lake. At that time, primary production of planktonic and benthic diatoms and chrysophyte algae in the lake fell almost to zero, and may have led to a general collapse of the Lake Baikal ecosystem.

Although Lake Baikal has provided the longest lacustrine record from continental Asia, there are many other shorter lake sediment records that are now available from the region. Most notable is the record from Lake Hovsgol in western Mongolia (51°N, 100° 30'E). This has provided a late Quaternary record from a site that is particularly sensitive to water balance changes. During the last glacial maximum (LGM), Lake Hovsgol was ~100 m below its modern level; it began to rise ~15.4 ka B.P. and by the beginning of the Holocene the lake level had risen to the point where it overflowed its basin. Many other lake sediment studies are currently under way, including high-resolution studies of Holocene sediments from South Korea, Tibet, and other parts of China, Russia, and Mongolia. High-resolution proxies from lake sediments show land-ocean-atmosphere coupling processes from low to high latitudes, linking tropical moisture with high latitude cold air activity during the Younger Dryas chronozone [*Zhou et al.*, 2001].

Important new records are available from speleothem deposits that provide insight into changes of both the East Asian and Indian monsoon systems. Of particular significance is a high-resolution record from Dongge cave (25°17'N, 108°5'E) which indicates the importance of orbital forcing on monsoon strength over the course of the Holocene, but also evidence for solar forcing on shorter timescales. Together with other detailed studies of loess, peat, ice cores, and lake sediments, a fairly detailed picture of climate variability during the Holocene is thus beginning to emerge.

The conference concluded with an overview of plans for coring Qinghai Lake (~37°N, ~100°E) in 2005 using the GLAD800 drilling system, and discussions about critical areas for future research in the region. High priorities for future research include studies designed to discern the relative strengths of the Indian (southwestern) and East Asian monsoon systems over time, as well as the role of westerly airflow in bringing moisture to the more northern and western parts of the region. Further modeling work is required to examine the relationships between aridification of continental Eurasia and the changing extent of drylands, dust flux, and climate evolution in other parts of the world.

There is also a need to better understand the history of permafrost development in the continental interior and its effects on vegetation and sensible heat flux over time. The importance of modern process studies to understanding and calibrating paleoclimatic records was also stressed.

Finally, it was noted that East Eurasia has a long history of human occupancy, with a rich paleoanthropological and archeological record. Examining changes in human evolution and the development of societies in relation to the network of increasingly detailed paleoenvironmental records from the region would be extremely valuable.

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