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Major reorganization of paleoclimate in Asia near the Oligocene/Miocene boundary

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Examinations on the spatial distribution of the environmental indicators define roughly EW zonal climate patterns in Asia throughout the Paleogene. A major reorganization occurred near the Miocene/Oligocene boundary, characterized by the formation of a monsoonal pattern similar to that of the present day. The onset of eolian deposition in northern China is roughly consistent with this major reorganization. The numerous alternations of loess and soil layers indicate the existence of sizeable deserts in the Asian inlands as dust sources, the winter monsoon as dust carrier, and an energetic summer monsoon as a supply of moisture. Recently, several lines of climate proxies have been developed from parallel eolian sections. These provide a near complete history of continental aridity in the Asian inlands, Asian summer and winter monsoons. For the early and middle Miocene portion, loess accumulation rates and eolian grain-size show rough-coeval changes and indicate moderate levels of aridity and winter monsoon strength. Their variations are significantly different from those of the marine oxygen isotope records, suggesting rather weak impacts of the ongoing global cooling. On the contrary, global cooling and the consequent expansion of Arctic sea-ice/ice sheets have strongly modulated the inland aridity and winter monsoon since the Late Miocene. Some of the events also coincide with proposed uplift of portions of the Tibetan Plateau. Strongest effects of the summer monsoons are observed for the early Miocene, then progressively decline during the Neogene. The drastic strengthening of summer monsoon at $\sim$8-7 Ma, as inferred by the cold foraminifera species in the Arabian Sea, is not obvious in the loess records in China. The cause is enigmatic and their explanation would require invoking combined effects of multi-factors associated

with the Neogene global cooling and tectonic changes.