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Holocene climate changes and their influence on cultural development in southern Siberia and Central Asia

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The cultural blooming and expansion of the Scythian cultures in the steppe zone of southern Siberia and Central Asia started during the 9th century BC, which correlates well with the early Subatlantic shift to cooler, wetter conditions, dated to ca 850 cal. yr BC (2750 BP) in Europe. This abrupt climate change was triggered by a decline of solar activity (Van Geel et al. 1998). In order to understand a possible climatic cause of the Scythian expansion we analysed palaeoenvironmental changes during the mid- late Holocene in these arid areas. Pollen records of sediment cores from two lakes were obtained: the fresh-water Kutuzhekovo Lake (53 36' N, 91 56' E, 320 m a.s.l.), located at the forest-steppe ecotone of the Minusinsk depression in Southern Siberia, and the brackish White Lake (52 03' N, 93 43' E, 830 m a.s.l.), located within the steppe zone of the Uyuk intermountain depression in northern Tuva. The regional climate is mainly controlled by Siberian air masses, nevertheless the area may also be influenced by the Westerlies and the Asian monsoon, which reach their limits here. The White Lake record shows a strong humid signal at ca 3930 BP after a period of long-term aridity during the mid-Holocene. The arid period is characterized by low pollen concentration and, among the xerophytic taxa, Chenopodiaceae dominance over Artemisia, indicating that desert and semi-desert persisted here. Biomass productivity, which is controlled by moisture availability in arid areas, was very low. A sharp rise of tree pollen values and total pollen concentration, taken together with a distinct decline of xerophytic taxa, is regarded as a wet signal. On the other hand, the highest concentration of shrub birch pollen indicates that it was cold at the transition to the wet period. The Kutuzhekovo Lake record from the less arid Minusinsk depres-

sion, around 250 km north-west of White Lake, also shows a distinct climate shift to wetter conditions. The site has a higher temporal resolution during the late Holocene, which allows us to distinguish asynchronous trends in temperature and precipitation: the coldest phase started ca 4310 BP, while the maximum humidity occurred between ca 2985 and 2470 BP. The highest values of Artemisia and low tree pollen abundance indicate arid (cold and dry) conditions during 4-3 kyr BP, when steppe and semi-desert dominated in the depression and mountain forest was strongly reduced. A sharp rise of Cyperaceae and a decline of xerophytic taxa clearly reflect an increase in effective moisture shortly after 3000 BP. The pollen record of two pine species, with a different ecology, shows a progressive forest shift down-slope (Pinus sylvestris starts to rise) in response to increased moisture availability, while relatively cold conditions persisting in highlands prevented forest from spreading up-slope (P. sibirica has a low abundance). Our records show corresponding climate change in both the Minusinsk and Uyuk depressions. In general, it was dry during the mid-Holocene, which is opposite to the widely perceived humid Holocene Optimum reported in Europe, eastern China etc., and even on a regional scale, such as Baikal and Western Siberia, but the dryness is consistent with data derived from arid to semi-arid zones in northern Mongolia (Peck et al. 2002) and Inner Mongolia (Chen-Tung et al. 2003). The discrepancy may be due to evaporation exceeding precipitation that reduced the effective precipitation. Conversely, during the cold period between 4-2 kyr BP a humidity maximum was recorded as a sharp climate shift, starting shortly after 3000 BP. Wetter and cooler conditions than today resulted in an increase in vegetation cover, higher biomass production and thus a higher carrying capacity in the Asian steppe zone, which became an attractive living area for Scythian nomads.