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Holocene climatic change, aeolian sedimentation and the nomadic Anthropocene in Eastern Tibet

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Geomorphological and palynological studies from the Nianbaoyeze Shan in Eastern Tibet provides detailed information on the Holocene landscape and vegetation development of a mountain system located on the westernmost boundary of the modern forest belt. In addition, detailed sedimentological work was done on a section south of the Anyemachin Shan further west. Our study provides detailed information on the late glacial landscape and vegetation development of eastern Tibet. Based on a suite of geomorphological and palynological proxy data from the Nianbaoyeze Shan on the eastern margin of the Tibetan Plateau (33°N/101°E, 3300-4500 m asl) we reconstruct recent landscape dynamics as a function of climate change and the longevity of human influence. Study results constrain several major phases of aeolian sedimentation between 50 - 15 ka and various glacier advances during the Late Pleistocene, the Holocene and the Little Ice Age (LIA). Increased aeolian deposition was primarily associated with periods of more extensive glacial ice extent. Fluvial and alluvial sediment pulses also document an increase of erosion starting at about 4000 cal yr B.P. coinciding with cooling (Neoglacial) and a growing anthropozoogenic influence. Evidence for periglacial mass movements indicate that the late Holocene cooling started at around 2000 cal yr B.P. demonstrating increased surface activity under the combined effects of human influence and climate deterioration (LIA). In a section south of the Anyemachin about 150 km further west Holocene silt and paleosols development match to these results but showing higher Holocene aeolian activity. The Holocene vegetation history started with an open landscape dominated by pioneer shrubs along braided rivers (<10,600 – 9800 cal yr B.P.), followed by the spreading of conifers (Picea, Juniperus, Abies) and Betula-trees accompanied by a successive closing of the vegetation cover by Poaceae, Cyperaceae and herbs (9800 – 8300 cal yr B.P.). First signs of nomadic influences appear as early as 7200 cal yr B.P., when temperatures were up to 2°C warmer than today. Forest remained very patchy with strong local contrasts. During the following cooling phase (5900 – 2750 yr cal B.P.) the natural Kobresia-mats were transformed by nomadic grazing to Bistorta-rich Kobresia pygmaea-pastures. Modern nomadic migration routes were established at least 2200 years ago. Overgrazing and trampling led to the shrinking of Bistorta and the spreading of annual weeds. Our data point to an early start of the nomadic Anthropocene at about 6000 years ago. Against this background of a very long grazing history, modern Tibet must be seen as a cultural landscape.