

When and why did floodplain sediments in Mongolia start to accumulate?

¹*Institute of Geography, Georg-August-University Göttingen;*

²*LIAG Institute for Applied Geophysics Hanover;*

daniela.sauer@geo.uni-goettingen.de

The aim of this project was to use floodplain sediments in Mongolia for reconstructing the Holocene landscape development. More specifically, we aimed at finding out, when the sedimentation of the thick floodplain deposits started, and which factors triggered the onset of floodplain sedimentation. Possible factors included mainly enhanced runoff and increased availability of sediment in the catchments - which led to the follow-up question, whether climatic or anthropogenic causes - or both - were the main drivers of those changes.

To tackle these questions, we described profiles in stratified floodplain sediments, analysed them for particle size distribution and organic carbon content, and subjected suitable sediment samples to luminescence dating, and organic material to radiocarbon dating.

The sediment bodies were usually 50-200 cm thick in total, but sometimes reached more than 4 metres thickness. The profiles exhibited sequences of layers of alluvial and aeolian fine material, alternating with humic layers and palaeosols. The thickness of the layers ranged from centimetres to decimetres.

We interpret the alternation of alluvial and aeolian layers as follows: The alluvial sediments primarily accumulated during episodic flood events. After their deposition, the bare sediment surface often acted as a dust source, which led to deflation and aeolian redeposition of sediment, before reestablishment of a vegetation cover stabilised the surface.

The accumulation of the floodplain sediments must have been triggered by a regime with increased surface runoff leading to enhanced flooding dynamics, and by accelerated soil erosion in the catchments. A decline in vegetation cover may provide an explanation for both processes: It would cause increased surface runoff because of reduced interception and transpiration. Enhanced surface runoff and reduced protection of the soil surface by vegetation would in turn result in accelerated erosion.

Most of the layers showed ages of less than 2 ka, and the ages of the lowermost layers of the sediment sequences ranged between 4.5 ka and 2 ka. Apparently, sediment deposition happened very rarely in the period between the end of the Late Glacial to the Late Holocene, and the main upbuilding of the sediment sequences started around 2000 years ago.

This change might have been caused by a climate change towards more heavy precipitation and longer periods of drought leading to vegetation decline. In addition, anthropogenic logging of forests and the use of fire, as well as intensification of pasture most likely led to enhanced surface runoff and accelerated soil erosion.

Archaeological evidence of animal husbandry in Mongolia goes back to the Early Bronze Age. It started about 5000 years ago with the appearance of the Afanasievo, Okunev and Andronovo cultures. However, substantial human impact on the landscape only began 2000 years ago, with the Xiongnu culture, Turkmen, Uyghurs, Kyrgyz and Mongols, prevailing one after the other. This probably marks a turning point of enhanced socio-economic development and rapid increase in population, accompanied by an increase in livestock and grazing pressure. Further research is needed to determine the extent to which climate change also played a role in this transformation.

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