Floodplain evolution in the Shiribeshi-toshibetsu River lowland, Hokkaido

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Low-gradient, fine-grained floodplains generally evolve by aggradation of fluvial deposits such as overbank deposits and crevasse-splay deposits. Therefore, the depositional history of these deposits has attracted much attention in studies of fluvial geomorphology and geology. However, few studies have constructed detailed chronologies of floodplain evolution, and the influence of sea-level and climate changes at submillennial time scales is not clear. This study investigated the Holocene evolution of the floodplain in the Shiribeshi-toshibetsu River lowland, Hokkaido, and reveals the impact of sea-level and climate changes on the floodplain evolution.
The Shiribeshi-toshibetsu River has a catchment area of approximately 720 km^2, and its current length is about 80 km. The floodplain of the Shiribeshi-toshibetsu River is about 2 km wide, and its northern and southern edges are bordered by uplands and terraces. Oxbow lakes are common in a well-defined meander belt near the present channel, and there are six large peatlands outside of the meander belt. The peat are 3–6 m thick.
Thirteen sediment cores were collected from four peatlands with a hand auger that recovered sediments from depths of up to 5 m and samples were collected at intervals of 5 cm. Loss on ignition was measured at intervals of 10 cm to quantitatively classify peat and organic-rich mud. Radiocarbon dating was conducted on plant and wood fragments and twigs using accelerator mass spectrometry. Two cross sections were constructed from existing columnar sections to show the stratigraphy beneath depths penetrated by hand augers.
The auger cores and cross sections demonstrate that thick and laterally continuous peat beds overlying fluvial deposits predominate in the uppermost part of the Holocene deposits. These relatively coarse deposits in an aggrading floodplain are likely natural levee deposits or crevasse-splay deposits, and the abandonment of crevasse splays and natural levees may have led to the peat formation. A radiocarbon age suggests that the peat initiation locally predates 6500 cal BP. Peatlands continued to expand until they reached their greatest extent at ca. 4000 cal BP. The similarity of peat onset ages at some sites in different areas suggests that a strong allogenic control reduced fluvial activity and led to the abandonment of crevasse splays and natural levees at ca. 5300–5000 and 4100–3900 cal BP.
The two periods of peat initiation at ca. 5300–5000 and 4100–3900 cal BP may correspond to decreases in precipitation from the weakening of the East Asian summer monsoon (EASM) at ca. 5600–5000 and 4000–3500 cal BP. The decreases in precipitation from the weakening of the EASM have been reported from many stalagmite records. Furthermore, decreases in the strength of the EASM at these times have been inferred from pollen records and lake-level records from multiple proxies. The continuation of peat accumulation after 4000 cal BP is consistent with the decreased precipitation after the events. Therefore, decreased precipitation may have reduced the water discharge from the upstream catchments, which in turn may have resulted in the abandonment of crevasse splays and natural levees. A similar fluvial response in the Ishikari lowland, Hokkaido, has been attributed to the weakening of the EASM.
On the other hand, the evidence in this study indicates that peatlands were moderately widespread before the inferred weakening of the EASM. In general, rapid sea-level rise during the early Holocene induced rapid aggradation of coastal floodplains through frequent crevassing and avulsion. Therefore, it is considered that aggradation slowed along with the pace of sea-level rise after ca. 7000 cal BP. The local peat initiation before 6500 cal BP in the lowland may be strongly associated with the deceleration of

sea-level rise.

Keywords: floodplain, peat, sea-level change, climate change, East Asian summer monsoon, Holocene

