Avulsion And Crevassing In The Lower Niobrara River, Northeast Nebraska: Complex Response To Base-Level Rise And Aggradation

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Abstract. Between 1995 and 1997 a series of crevasse splays formed and several avulsions occurred in the lower portion of the sandy, braided Niobrara River, northeastern Nebraska above its confluence with the Missouri River. Most of these events can be related to a maximum 2.9-meter base-level rise and aggradation of the main Niobrara channel belt that began in the 1950s following damming of the Missouri River. Crevasses and avulsions, along with a rising groundwater table turned the lower 3.3 km of the Niobrara, above its confluence with the Missouri, into an extensive wetland with characteristics and processes similar to those found in anabranching rivers.

Forty-three years of aggradation on the lower Niobrara River led to a significant decrease in downstream gradient and a consequent increase in cross-valley gradient. Aggradation of the channel belt led to the avulsions that were initiated as crevasse splays. Crevasses formed at low points along river banks and levees, and were constrained locally by floodplain topography and man-made structures. Timing of crevasse initiation was linked to localized bank erosion or the presence of ice dams rather than to increased discharge. During formation of the crevasse splays floodplain aggradation occurred rapidly, with up to 1.5 m of sediment deposition in a year. Some of the crevasses became avulsions and the lower Niobrara River evolved from a braided to an anabranching or distributary system, reactivating old channels and flowing across former islands and floodplains. This pattern of relatively long-term, systematic channel-belt aggradation followed by short-term, dramatic change is interpreted to indicate the crossing of a geomorphic threshold beyond which the river behavior changed from aggradational to avulsive. Data support models for avulsion occurring when there is a decrease in channel belt slope and/or an increase in cross-valley slope, and indicate that aggradation and super-elevation of the channel belt is a major factor in allowing avulsion to occur and persist. In the Niobrara, the major external factor forcing channel change was a significant rise in base level.

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