FLUVIAL GEOLOGY IN EASTERN NEBRASKA

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Problem: The confluent Platte River-Elkhorn River floodplain in eastern Nebraska lies at the expanding western margin of the Omaha metropolitan area. Recreational, residential, and agricultural land use dominates the area, but flooding and high water tables are important concerns. Episodic overbank flooding results from the blockage of channels by ice jams in the braided Platte. Ice jams are triggered by relatively abrupt weather changes in mid- or late winter, and have the potential to cause significant property damage as land use intensifies.

The Geologic Map: A portion of our USGS Valley, Nebraska 7.5 minute quadrangle geologic map (Fig. 1) shows alluvial geomorphology and surficial sediments between the braided Platte and meandering Elkhorn rivers near Valley, Nebraska. Young, sandy alluvium (not shown) and successively older Quaternary alluvium (Qap2, Qap3) lie along the Platte. Two successive generations of Quaternary alluvium (Qae1, Qae2) are mapped along the Elkhorn. The youngest Elkhorn alluvium (Qae1) has prominent scroll bars that are locally visible at ground level as ridges 0.3-1 m high. Much of the deposition of Qae1 can be attributed to the time since extensive channel straightening and dredging was carried out in 1912. Flood channels mapped on the distal Platte alluvium (Qap3) transmit floodwaters from the Platte downslope (southeastward) into the Elkhorn. Splays on Qap3 occur near the Platte or at the ends of flood channels and represent the rapid deposition of sediment by escaping floodwaters. Some of these splays definitely received sediment in a major flood during March 1993. A sand ridge, one of multiple examples found during mapping, is shown in Qap2, nearer to the active channel belt of the Platte. These 3-5 m high ridges extend for a few kilometers parallel to the Platte and represent either natural levees reshaped by eolian processes, or dunes that accumulated along a former tree line.

Applying the Geologic Map: The mapping of flood channels and splays eastward from the Platte River clearly delineates a specific type of flooding hazard– one that should be of great concern to real estate developers and agriculturalists. In essence, mapping leads to an explanation of the mechanism of overbank flooding along the Platte. The recognition of two successive generations of Elkhorn River alluvium dramatically illustrates the rebound of a meandering stream after extensive engineering, and demonstrates that the river is now highly active in terms of avulsion, bank caving, and the lateral migration of meanders. Multiple structures were found to be at risk where meanders are migrating rapidly into the floodplain.

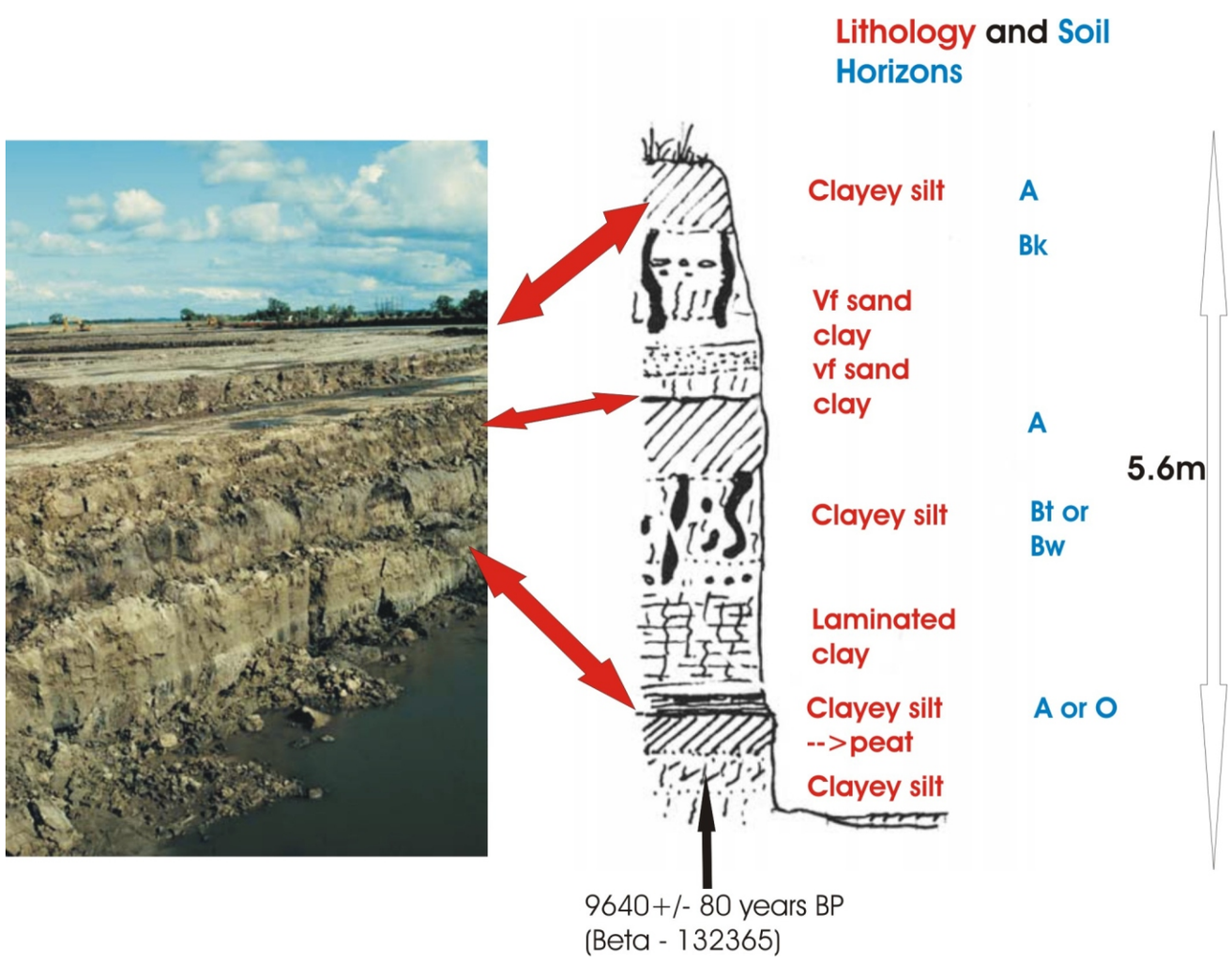

Figure 2. Borrow pit in overbank sediment adjacent to flood channel

Discussion: The Platte River has built up an alluvial ridge that is significantly higher than the surrounding confluent floodplain of the Platte and Elkhorn. Prior to mapping, there was a general recognition of this relationship, but a specific mechanism for the movement of floodwater out of the Platte had been postulated. Mapping has revealed that floodwaters flow through gaps in natural barriers (sand ridges) and artificial levees and follow pre-existing flood channels. Fine-sandy sediments exposed in a borrow pit in Platte alluvium (Fig. 2) include two paleosols and yield ^{13}C dates indicating that splay deposition has occurred episodically at the site since 10 ka. Thus, the Platte does not appear to have undergone any avulsion in this area since the end of the Late Pleistocene. Rather, in-situ vertical aggradation of the active channel, flood channels, and splays appears to have occurred.

Conclusion: Mapping in the Platte-Elkhorn alluvial valley clarifies the behavior of the Platte and Elkhorn rivers in flood, identifies details of fluvial landscape evolution that were hitherto undocumented, and provides a basis for more effective planning in land use near the urban core of eastern Nebraska.