Geophysical Research Abstracts
Vol. 20, EGU2018-3126, 2018
EGU General Assembly 2018

Using integrative floodplain ecosystem dynamics to reconstruct channel avulsion: A case study from the Bighorn Basin, Wyoming

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River avulsion plays a key part in our understanding of sediment distribution, architecture and stratigraphy in fluvial and basin fill stratigraphy. In the sedimentological record, two types of avulsion deposits are commonly recognized: progradational and abrupt. However, sedimentary features that are important in the identification of avulsion, such as increased sand deposition with increasing proximity to the main channel, may either not be developed in suspended load dominated fluvial systems or may be missing due to floodplain erosion during channel migration. This can lead to potential misinterpretation of avulsion patterns. To recognize avulsion independently from sedimentological observations, we characterized the floodplain plant ecosystem and its response patterns to channel migration, using a combination of floodplain palynology and geochemistry combined with sedimentary data from fluvial successions of the Eocene Willwood Formation in the Bighorn Basin, Wyoming.

Our data indicate a close relationship between floodplain plant ecosystem properties, pedogenesis and proximity to the main channel and splay complex. Sediment geochemical analysis combined with palynological examination of putative abrupt avulsion deposits suggests that dilute, suspended-load dominated floods were common throughout floodplain deposition, and gradually increased in frequency and proximity prior to emplacement of the main channel. This implies that suspended-load dominated flows form a more important component in floodplain deposition than previously recognized, and that progradational avulsion is more common in the studied sections than preserved sediment lithofacies suggest. This contrasts with the sedimentological interpretation of previous studies of similar sections in the basin.

The integration of floodplain plant ecosystem analyses with sedimentological data provides a key approach in the study of floodplain dynamics and channel migration, and allows development of a more refined assessment of avulsion patterns than studies based solely on sedimentological observations. The findings of this study support the importance of floodplain dynamics in influencing channel migration. Integrating floodplain ecosystem data with sedimentary data therefore forms a key part in modelling avulsion and sediment distribution in continental basins.