

Peak-discharge variability in meandering rivers: linking morphodynamics to sedimentary products

(Proposer: Prof. Massimiliano Ghinassi)

River channels planform, such as straight, braided and meandering, are still crucial features for most models used by sedimentologists to investigate alluvial successions. Nevertheless, the use of a planform-based approach to investigate river systems and related deposits has been repeatedly criticised, because: i) river channels can show transitional features between planform styles, ii) several rivers display different planforms at different flow discharge, and iii) contrasting planform styles can also coexist within the same river reach. A novel approach to investigate fluvial system and relate deposits, suggests the use of peak discharge variability (i.e. variability in peak annual discharge over a multi-year period; PDV), since sedimentological features of some modern and ancient alluvial succession seems to correlate strongly to peak discharge variance. Insights emerged from these new studies outlined a new approach to fluvial sedimentology, but require to be furtherly tested through integrated and focused investigations.

This PhD project aims to detect the signature of PDV in river meander bends and related point bar deposits. This goal will be achieved through morphodynamic, sedimentological and experimental investigations, which will represent the three major steps of this PhD project. Morphodynamics investigations (collaboration with Dr. A Ielpi, Laurentian University, Canada) will focus on the comparison between morphometric features (i.e. sinuosity, radius of curvatures) and planform behaviour (e.g. migration rate) of selected meander bends from rivers with different PDV rivers. Sedimentological investigations will be aimed at depicting facies and architectural features for a selected meandering river with a high PDV, and to compare them with those of low PDV rivers well-documented in literature. The study case for this work (collaboration with J. Moody, USGS, emeritus) is the freely-meandering Powder River (Montana, US), where annual morphological changes of 22 channel cross-sections have been documented for more than 40 years. This unique dataset can be used to establish a correlation between measured water discharge and related sedimentary products which will be made visible through excavation of extensive trenches. Experimental studies will be carried out at a new experimental facility set up at the Department of Geosciences, and will be aimed at verifying the effects of PDV on morphodynamics and (micro-) stratal architecture in experimental meandering rivers (collaboration with A. Finotello, University of Venice).

Expected Results

The results of this project will allow the PhD candidate to quantify the effects of PDV on meandering river channels in terms of morphometry, planform dynamics and sedimentary products.

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