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Linking sediment properties with conductivity values: an approach to investigate intra point bar grain-size variability in fluvial deposits

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Fluvial and fluvio-tidal meandering channels are widespread in coastal areas, where they shape the present-day landscapes and build up thick sedimentary successions. Deposits accumulated by these channels host the most surficial aquifers, which are deeply exploited by agricultural and industrial activities. Understanding sedimentary facies distribution within these deposits is crucial to predict groundwater flow and also has relevant implications for aquifer management.
This study focuses on deposits accumulated by a late Holocene meandering river of the Venetian Plain (Northeast Italy). Combining remote sensing and geophysical data, sedimentary cores, and statistical analyses, we characterize the geometry and sedimentology of two adjacent point-bar bodies, with a specific focus on along-bar sediment grain-size distribution.
The study paleochannel is ca. 30 m wide and its planform evolution was reconstructed by analyzing the scroll-bar pattern of the related point bars from satellite images. This channel generated two meander bends, namely B1 and B2, that progressively expanded during their evolution; moreover, bend B1 was affected by a downstream rotation of the bend apex during its final stage of growth.
Geophysical investigations (Frequency Domain Electro-Magnetometer) provided information about the electric conductivity of the studied sedimentary bodies by allowing for the visualization of horizontal 2D maps with averaged conductivity values with a vertical resolution of 1 m. Point-bar bodies are characterized by slightly lower conductivity values (7 to 80 mS/m) than channel-fill deposits (49-147 mS/m), whereas overbank deposits exhibit the highest values (115 to 300 mS/m). In the B1 point-bar, conductivity values reflect the scroll-bar pattern and are lower in the upstream and pool zones, whereas, in the B2 point-bar, the conductivity exhibits almost uniform horizontal values at each depth.
Sedimentary cores reveal that the two point bars consist of well-sorted sands, ranging from fine to very coarse sand, with no heterolithic deposits. Bar deposits cover a basal lag consisting of very coarse sand with shell fragments. Channel-fill deposits are made of fine to very fine sand with muddy intercalations. Overbank deposits consist of massive mud, which is locally organic-rich.
The combination of core analysis and conductivity maps highlights a correlation between conductivity values and sediment textural properties, revealing that finer sediments (i.e., mud in overbank areas) are more conductive than coarser ones (i.e., sand in the point-bar bodies). These

observations provide information about the spatial distribution of grain size at different depths, showing the occurrence of different vertical grain-size trends within point-bar deposits. Moreover, statistical analyses reveal that the conductivity values in bar deposits are primarily influenced by the grain-size sorting, and subordinately by grain size and composition.
Our findings provide a link between planform evolution of fluvial bends and grain-size distribution within the related bars, with implications to predict subsurface flow propagation within alluvial sedimentary bodies.