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Using Electric Resistivity Tomography and Borehole Logs to Detect Sedimentation Changes in a Gravel-Bed Ephemeral Channel

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Differences in deposit geometry and texture with depth along ephemeral gravel-bed streams strongly reflect fluctuations in bedload, which occur due to environmental changes at the basin scale and morphological channel adjustments. In this study, non-destructive methods, 2D and 3D electrical resistivity tomography(ERT), have been combined with datasets from borehole logs to identify, quantify and analyze the internal geometry of cross-sections of the gravel-bed ephemeral channel, known as Azohía Rambla (southeastern Spain). The electrical survey was performed through longitudinal and transverse profiles in two channel reaches, upper and middle stretches. Both profiles utilized 28 stainless steel electrodes reaching 14-30 m in length and an investigation depth of 3-5 m, approximately. Electrical resistivity values were correlated with data obtained from the samples collected from borehole logs (e.g. sediment strength, grain size distribution, compaction, porosity (□), and hydraulic conductivity (k)). To determine □ and K granulometric and morphometric variables, such as shape-sphericity indices, particle sorting, effective grain-sizes and void ratios, were used.

The alluvial channel-fills showed the superposition of four layers with uneven thickness and arrangement: 1) a lower sandy-gravel body, scarcely thick, characterized by moderate resistivity (150-500 Ω · m); 2) a thicker intermediate layer, with moderate to high resistivity values (500 to 1600 Ω · m); and 3) an upper set composed of coarse gravel and supported matrix, ranging from 1600 to 3000 Ω · m, and a narrow subsurface layer, the most resistive (> 3000 Ω · m), corresponding to the most recent armored deposits (gravel and pebbles). Consequently, the ERT results coupled with borehole data suggest that since the channel entrenchment in the Miocene marl substrate, different pulses of vertical sedimentary accretion were produced, denoting a general trend to increase in grain-size (coarsening-upwards) and hydraulic conductivity towards the top of the sedimentary sequence. This research was funded by ERDF/Spanish Ministry of Science, Innovation and Universities—State Research Agency/Project CGL2017-84625-C2-1-R; State Program for Research, Development and Innovation Focused on the Challenges of Society.