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Ground-penetrating radar for sedimentology: methodological advances and examples from the Usumacinta-Grijalva delta plain, Tabasco, México

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Ground-penetrating radar (GPR) is widely used as a tool for imaging sedimentary structures and reconstructing depositional history in a range of settings. Most GPR systems use a pair of dipole antennas to transmit and receive electromagnetic energy, typically in the frequency range of 0.025–1 GHz. Radar reflections result from contrasts in dielectric properties, which can be induced by small textural variations between layers. To generate cross sections of the subsurface, the common-offset antenna pair is moved along surface transects. The GPR method benefits from its relative ease of use and relatively limited basic processing that is required for interpretation of field data. Drawbacks include the high signal attenuation in electrically conductive material such as clay and the trade-off between penetration depth and resolution for different antenna frequencies.

In recent years, various equipment advances and novel field practices and processing strategies have improved the ability of GPR to provide high-resolution data in a wider range of settings and scenarios. Advances include multi-channel systems for more efficient data collection, multi-offset data collection and processing for improved signal-to-noise ratios, full-resolution and multi-component imaging, and full-waveform inversion. In this presentation, we will discuss some of these methodological advances and present full-resolution field data from a highly heterogeneous fluvial site in Mississippi, USA. We will also present GPR data from a project focused on reconstructing depositional history of the Usumacinta-Grijalva delta in Tabasco, México, which is the world's largest beach ridge plain. Here we used common-offset GPR antenna pairs at two frequencies to assess the varying thickness of the eolian cover of individual beach ridges. We also characterized systematic changes in the dip of beach face and foreshore deposits to study its possible relation with temporal changes in coastal processes.