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Environmental and human impact on the sedimentary dynamic in the Rhone Delta subaquatic canyons (France-Switzerland)

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Deltas are very sensitive environments and highly vulnerable to variations in water discharge and the amount of suspended sediment load provided by the delta-forming currents. Human activities in the watershed, such as building of dams and irrigation ditches, or river bed deviations, may affect the discharge regime and sediment input, thus affecting delta growth. Underwater currents create deeply incised canyons cutting into the delta lobes. Understanding the sedimentary processes in these subaquatic canyons is crucial to reconstruct the fluvial evolution and human impact on deltaic environments and to carry out a geological risk assessment related to mass movements, which may affect underwater structures and civil infractructure.

Recently acquired high-resolution multibeam bathymetry on the Rhone Delta in Lake Geneva (Sastre et al. 2010) revealed the complexity of the underwater morphology formed by active and inactive canyons first described by Forel (1892). In order to unravel the sedimentary processes and sedimentary evolution in these canyons, 27 sediment cores were retrieved in the distal part of each canyon and in the canyon floor/levee complex of the active canyon. Geophysical, sedimentological, geochemical and radiometric dating techniques were applied to analyse these cores.

Preliminary data show that only the canyon originating at the current river mouth is active nowadays, while the others remain inactive since engineering works in the watershed occurred, confirming Sastre et al. (2010). However, alternating hemipelagic and turbiditic deposits on the easternmost canyons, evidence underflow processes during the last decades as well. Two canyons, which are located close to the Rhone river mouth, correspond to particularly interesting deeply incised crevasse channels formed when the underwater current broke through the outer bend of a meander in the proximal northern levee. In these canyons, turbidites occur in the sediment record indicating ongoing sediment dynamics during whether extreme flood events or mass-movements due to deltaic scarp failures. The active canyon shows a classic turbiditic system with frequent spillover processes in the canyon floor/levee complex. Geotechnical measurements, a decrease in the frequency of turbidites and a fining upward sequence along the levee suggest that erosion dominates sedimentation in the canyon floor, while sedimentation dominates in the rapid levee building-up process, with sedimentation rates that exceed 3cm/yr in the proximal areas. Therefore, mechanisms controlling the sedimentary evolution on the active canyon result in a complex interplay between erosion and sedimentation. Further research will provide a detailed evaluation of the human impact on sedimentary dynamic in the Rhone Delta subaquatic canyons.

References:

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