Factors Controlling the Geomorphological Evolution and Depositional Processes of a Modern Lacustrine Turbidite Channel-Levee Complex: The Modern Rhone Delta in Lake Geneva

Juan Pablo Corella[1], Katrina Kremer[2], Jean Gerard[3], Manuel González-Quijano[3], and Stéphanie Giradclos[4]

[1]Spanish National Research Council
[2]ETH
[3]Repsol Exploración S.A
[4]University of Geneva

Abstract

Modern deep-water channels on continental margins and in deep lacustrine systems are important features that funnel large amounts of sediment from land to the deep ocean and lake basins. Understanding their evolution and related depositional patterns have significant economic consequences as their ancient counterparts host important oil and gas reserves around the globe. The Rhone delta in Lake Geneva is a classic natural laboratory to understand sedimentological and geomorphological processes in river-dominated delta systems and, despite its small size, can be applied to understand larger ancient turbidites systems.

The Rhone delta in Lake Geneva is characterized by a delta top with a prograding foreset incised by nine channel-levee complexes and a distal fan depositional area. A multidisciplinary research strategy -including innovative coring using submersibles, in situ geotechnical tests, geophysical and sedimentological analyses, and time-lapsed bathymetric surveys- has been applied during the last decade in the Rhone delta. This research effort has enabled to understand the geomorphological evolution of these channel-levee complexes, as well as the spatial distribution, geometrical characteristics and frequency of turbidites and Mass Transport Complexes (MTCs).

Sediment cores retrieved in the distal area of each canyon indicate that the easternmost canyons have been inactive during the last decades, while the presence of turbidites in the westernmost canyons indicates ongoing turbidity currents related to either large floods or slope failures in the canyon walls. MTCs are frequently associated to lateral and/or cap seals from underlying turbidite reservoirs. In the Rhone delta, the largest MTCs occur in the distal basin, related to different sources and triggers. Interestingly, large MTCs (106 m^3 of sediment) are also found in the submerged channels influencing the channel morphological evolution by damming the distal conduit. They can be totally eroded in only a few decades, leaving no trace in the sedimentary record, but bearing important consequences for the location of the basin depocenter as they promote the formation of newer channels modifying the pattern of sediment conduits. The Rhone delta in Lake Geneva is a potential analog to improve the understanding and prediction of deepwater depositional systems and their associated reservoirs in areas with similar morphostratigraphic settings.