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Hierarchy of source-to-sink systems — Example from the Nile distribution across the eastern Mediterranean

Uri Schattner

Dept. of Marine Geosciences, Charney School of Marine Sciences, University of Haifa, Haifa, Israel (schattner@univ.haifa.ac.il)

A standard source-to-sink approach examines sediment transport along an imaginary axis (regarded here as primary) extending between land, the continental margin and a nearby basin. This approach oversimplifies the development of depositional environments located off the axis (regarded here as secondary). Similarly, it imposes that factors affecting the primary source (e.g. climate) will directly be reflected in the secondary sink. The current study examines this suggested hierarchy in a confined basin, where the sedimentary budget remains closed. It evaluates the mechanism connecting between the primary and secondary axes. The study focuses on the Nile sedimentary system, across northeastern Africa and the eastern Mediterranean basin (primary axis) and the Levant depositional system (secondary sink). The secondary river input into the Levant basin is negligible, emphasizing the role of the main secondary source - seafloor currents. The Levant Jet System (LJS) transports sediments from the Nile cone along the Levant margin at depths between 0 and 350 m, during the Holocene and until present. During periods when the LJS reaches its capacity to transport sediments, the surplus falls downslope to the deep basin. By integrating seismic and bathymetric data, this research suggests a unifying mechanism integrating deposition, erosion and transport of sediments across the Levant margin and basin throughout the Quaternary. Results show that during both highstand and lowstand conditions the primary source-to-sink axis delivers sediments to the deep basin via south to north meandering channels. The LJS transports sediments that build the shelf, while unconfined overspills slide downslope to accumulate across the continental rise. However, when sea levels drop, the capacity of the LJS weakens. This results in a drastic decrease in sedimentation across the shelf and rise, accompanied by confined downslope turbidity flows into the deep basin. Hence, seafloor currents serve as an immediate supplier from the mouth of the primary source (i.e. a major river) to the off-axis system. Variations in seafloor current dynamics and their capacity to transport sediments will be directly reflected in the secondary sink. The primary continental source is expected to have only an indirect effect on the secondary sink.