Sedimentary Structure Distribution and Modification on the Continental Shelf: Relative Roles of River Input, Sediment Transport and Oceanographic Setting

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Studies of sedimentary structures in modern shallow marine environments influenced by rivers have been conducted in active and passive margin settings from numerous areas worldwide (e.g., shelves adjacent to the Amazon, Mississippi, Eel, Waipaoa Rivers). Despite the large differences in scale between such systems, the offshore progression of sedimentary structures has many similarities. Factors indicated in the control on fine-scale sedimentary structures and their post-depositional modification include: episodicity of river inputs, sediment transport mode, water depth and wave base, biological activity and the sediment accumulation rate. Many previous studies have suggested sediment accumulation rate as a dominant control on the preservation of primary physical structures on the continental shelf. However, results from recent studies suggest that, within the normal range of accumulation rates observed in shelf environments, other factors such as water depth, flood input history, and proximity to sediment source are the dominant controls on the occurrence and preservation of physically emplaced sedimentary structures. The timing and history of river flood and storm events is one factor in determining the distribution of event layers on the shelf, and their ultimate preservation. For example, concomitant river flooding and storm conditions favor the generation of wave- and current-supported gravity flows capable of broadcasting flood sediments across the shelf. Out of phase flooding would favor rapid deposition in nearshore and shallow shelf environments. The resultant flood layers have a higher preservation potential if they are buried quickly by deposition during subsequent large floods. Surface gravity waves cause physical reworking of the seabed in water depths shallower than wave base, obliterating original structures and winnowing the seabed of fines, but creating layers and laminations which may be similar (albeit coarser) than originally emplaced flood layers. In deeper waters, reworking of primary sedimentary structures arises from biological activity in the near-surface seabed, and the preservation of physically emplaced structures depends on the relative importance of biological mixing depth and intensity, and the sediment burial rate and history. These studies indicate that factors other than long-term accumulation rates primarily influence the formation and preservation of fine-scale sedimentary structures on the continental shelf.