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Fates of River-Derived Sediments to the Sea: Longshore vs cross-shelf transport

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Collectively, the global rivers annually discharge about 35,000 km˝3 of fresh waters and 22-22×10˝9 tons of solid and dissolved sediment to the ocean. Among them, approximately 70% has been delivered from Asian large rivers (e.g. Yellow, Yangtze, Pearl, Red, Mekong, and Ganges-Brahmaputra, etc) and numerous small mountainous rivers (e.g. rivers in Taiwan, Indonesia, and Papua New Guinea, etc) into the Western Pacific marginal seas, e.g. Yellow Sea, East China Sea, and South China Sea.

Recent-year field studies off the Yellow, Yangtze, Pearl, and Mekong show nearly 50% of these river-derived sediments has been deposited in the lower reach of the river mouth, forming many extensively distributed subaerial delta plain, and rest of them discharges into the adjacent seas. Among those being discharging into the ocean, nearly half of them (20-30% of the total) has been found to be longshore-transported several hundreds kilometers from the river mouth. This is also true in other large river systems in the passive margins, like Amazon. There is very little or few percent of the total sediment discharge has been found to be across-shelf transported into the deep ocean. Some are transported down through the adjacent canyon systems, such as Indus and Ganges. Some field observations and modeling results indicate that the driving and controlling forces for the strong longshore transport include the strong seasonal coastal current, tide and wave actions, downwelling and upwelling circulations, etc.

In contrast, sediment from small rivers has a very different fate. Some major small mountainous rivers in active margins (e.g. Eel, Kaoping, Choshui, Lanyang, Waipaoe, etc), usually do not form large-scale deltas and are mainly controlled by episodic events, contribute more than 50% of global terrigenous sediments to the sea. However, more than 80% of their sediment discharges are transported directly to the shelves or deep canyons mainly via gravity/turbidity or hyperpycnal flows, which are distinctly different from the above large rivers that discharge to passive margins or shallow marginal seas.

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