Fates of Major Asian River-Derived Sediments to the Ocean

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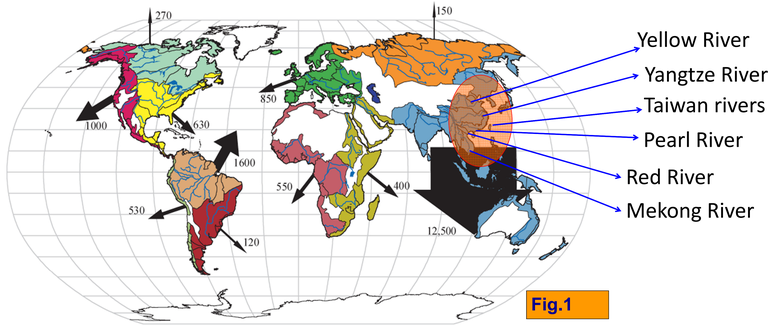
Collectively, the global rivers annually discharge about 35,000 km^3 of fresh waters and 22-22 $\times 10^9$ tons of solid and dissolved sediment to the ocean. New estimate based on historical gauge data from thousands rivers by Milliman and Farnsworth (2011) shows that global rivers could collectively deliver **19** $\times$**10^9** tons per year of suspended sediments to the coasts and seas (**Fig.1**).



Milliman, J.D. and Farnsworth, K.L., 2011. *River Discharge to the Coastal Ocean: A Global Synthesis*. Cambridge Univ. Press, 392 p.

Question: Where did those fluvial sediments go?

- How much are left on land?
- How much formed the subaqueous delta?
- How much have been transported into the middle shelf?

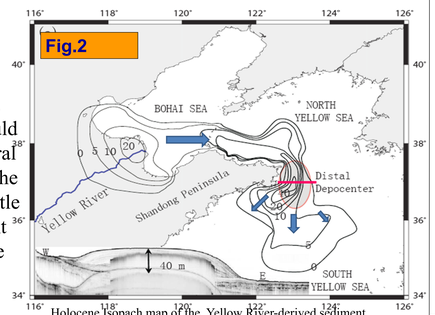
How much really reached the sea?
How much stayed in the inner shelf?
How much could reach the deep sea?

Recent Studies:

The Yellow River

Historically, nearly 40% of the Yellow River's flux has been left on land and built an extensive subaerial delta plain.. The Yellow River-derived sediment could reach the -75 m water depth in the central South Yellow Sea, about 700 km from the river moth (**Fig.2**); in contrast, a very little fraction of the modern riverine sediment could escape the outer shelf or reach the Okinawa Trough.

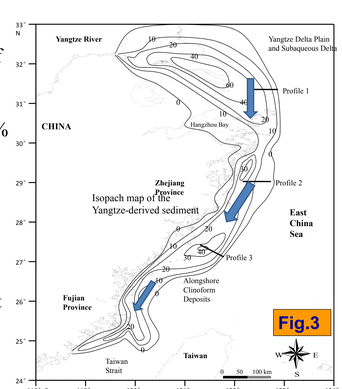
(after Liu et al., 2004, Yang and Liu, 2007)

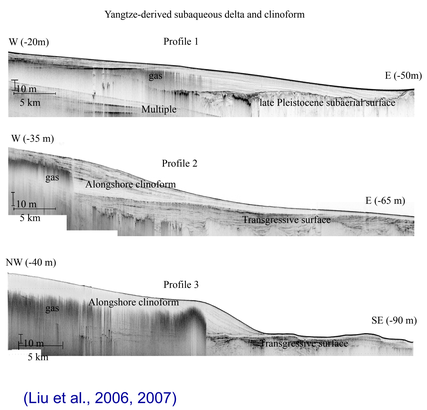


Holocene isopach map of the Yellow River-derived sediment

The Yangtze River

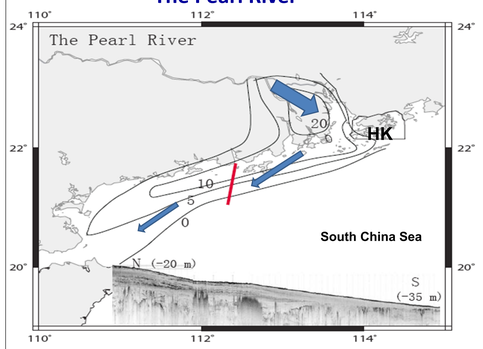
In the past 7000 years, nearly 50% of the Yangtze River-derived sediment has been accumulated in it lower reach and built an extensive delta plain. About 20% deposited at the proximal subaqueous delta, and 30% has been longshore transported southward in the East China Sea inner shelf, about 800 km from the river mouth, and all the way into the Taiwan Strait; in contrast, a very little fraction of the modern riverine sediment could escape the outer shelf or reach the Okinawa Trough (**Fig.3**)





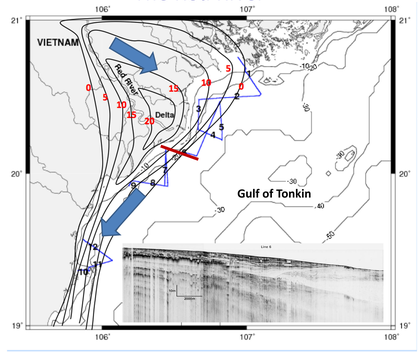
(Liu et al., 2006, 2007)

The Pearl River



(Liu et al., 2009)

The Red River



The Mekong River

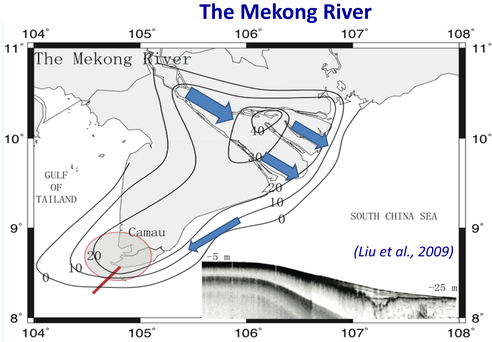


Figure 5. Isopach map of Mekong River-derived sediment discharged to the sea (isopachs in meters). A select seismic profile (red line) across the remote nearshore depocenter is also shown. (onshore data from Nguyen et al., 2000; Ta et al., 2002)

Holocene riverine mud accumulation (in meter) in the South China Sea

Taiwan Small Mountainous Rivers

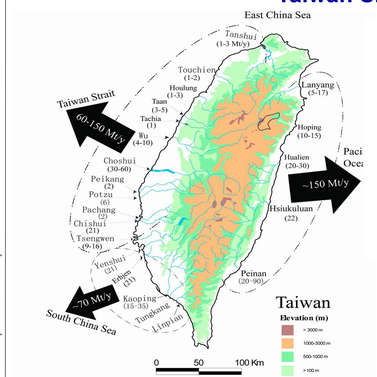
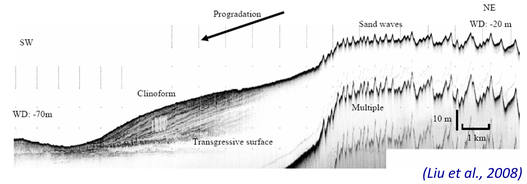


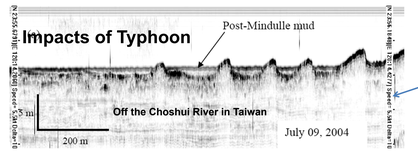
Fig. 2. Distribution of Taiwan mountainous rivers and their annual sediment loads to the surrounding seas.

Citation: J.P. Liu, C.S. Liu, K.H. Xu, J.D. Milliman, J.K. Chiu, S.J. Kao, S.W. Lin, 2008.Flux and Fate of Small Mountainous Rivers Derived Sediments into the Taiwan Strait. Marine Geology, Vol. 256, pp. 65-76. doi: j.margeo.2008.09.007

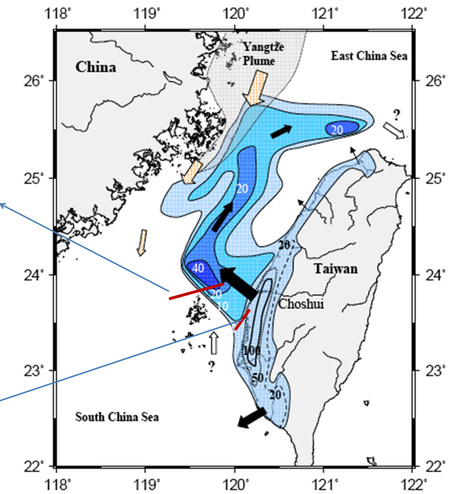


(Liu et al., 2008)

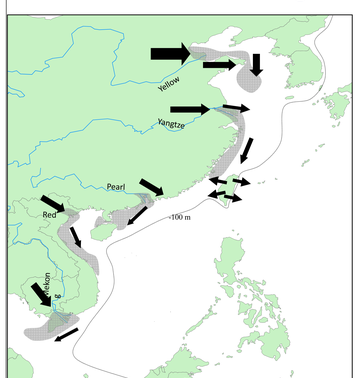
Fig. 6. Chirp sonar profile in the central southern Taiwan Strait, offshore the Choshui River mouth, shows a subaqueous delta prograding southwestward, and ends at water depth, -70 m. Topset of the clinoform is dominated by distinct sand waves, 2-5 m high.



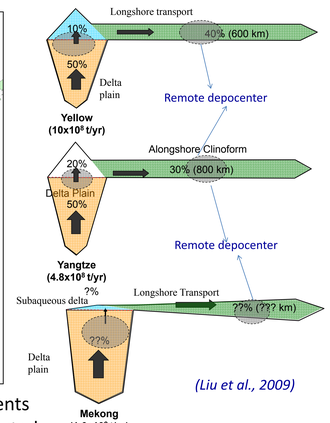
(Milliman et al., 2007)



Fates of Asian Large Rivers-Overview



Overall, Asian large rivers-derived sediments have been extensively longshore transported, usually with a remote depocenter.



(Liu et al., 2009)

Conclusions

Our new study suggest that nearly **40-50%** of the large river-derived sediments have been retained in river mouths and formed extensively distributed delta plains, while the rest are discharged to the sea. About 10-20% has been found to accumulate near the river mouth where then formed various subaqueous delta systems. The remainder (~30%) is found to be transported farther away (**600-1500 km**) along the shore, usually with a predominant remote /distal depocenter away from its river mouth.

In contrast, sediments from **small mountainous rivers** in active margins (e.g. Choshui in Taiwan) have a very different fate, they usually do not form delta plain and are mainly controlled by episodic events, and , more than 80% of their sediment discharges are transported directly **to the shelves or deep canyons.**

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