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Sediment Budget in the Taiwan Strait with High Fluvial Sediment Inputs from Mountainous Rivers: New Observations and Synthesis

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ABSTRACT

The shallow Taiwan Strait at the southern opening of the East China Sea (ECS) receives abundant sediments from turbid mountainous rivers in Taiwan. The volume of sediment is among the highest sediment yields on the global surface. This large amount of sediment discharged from modern Taiwan (range: 175 - 380 Mt y^{-1} based on 50-yr data) is comparable to that discharged from Changjaing (500 Mt y^{-1}-decreasing in recent decades), underscoring the importance of sediment budget in the Taiwan Strait and sediment flux from Taiwan into the ECS. We documented fluvial mud and sand concentrations during flash flooding with our observations indicating that fluvial materials in Taiwan's rivers are chiefly composed of mud (> 70% and up to 98%). By contrast, sand fraction dominates (> 85% for most stations) surface sediments in the Taiwan Strait. Super typhoon Herb alone delivered 130 Mt of sediments from Choshui, the largest river in Taiwan, yet only insignificant amounts of mud were found at the river mouth six months later. The actions of waves, tides, and currents apparently prevent the deposition of fine grained sediments. Assuming sand occupied 30% (the maximum) of the 60 Mt y^{-1} total sediment input from major western Taiwanese rivers, our annual budget estimate shows that the amount of sand input (18 ± 5 Mt y^{-1}) is comparable to the burial output of sand (12 ± 10 Mt y^{-1}). However, mud burial (6 ± 5 Mt y^{-1}) in the strait is far below the estimated mud input (42 ± 11 Mt y^{-1}), resulting in a significant shortfall. Hydrodynamic conditions were synthesized to explain the distribution pattern of limited mud patches in the strait and to reveal potential pathways by which fine-grain sediment transportation takes place in the seas surrounding Taiwan. A significant shortfall in the mud budget in the Taiwan Strait suggests that ~85% of the fluvial mud left the strait. Alternatively, the 50-year modern sediment flux data used in this study reflects exacerbated sediment flux due to human activity and is possibly too high to represent loads during pre-Anthropocene. Additional studies are needed to explore the flux and fate of mud in and surrounding Taiwan over a longer time scale.

Key words: Mud, River, Sediment, Sedimentation rate, Taiwan Strait

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1. INTRODUCTION

More than 90% of world riverine sediments are deposited on the continental margin; allowing this zone to play a key role in linking the terrestrial and oceanic carbon cycles (Thomas et al. 2004; Deng et al. 2006). The East China Sea (ECS) is the most important marginal sea in the western Pacific as it is the interface between the world's largest continent (Asia-Europe) and the Pacific Ocean (Fig. 1). Approximately 10% of world's fluvial sediments are delivered to the ECS from two large rivers, i.e., Changjiang and Huanghe (Milliman and Meade 1983). In addition, the annual sediment output from Taiwanese rivers is ~184 to 380 Mt y^{-1} (Dadson et al. 2003; Kao et al. 2005), which is comparable to the sediment flux from the largest river, Changjiang, in China (500 Mt y^{-1}; Milliman et al. 1985), particularly when Changjiang's and Huanghe's sediment loads are both decreasing (currently 200 Mt y^{-1} for Changjiang, Xu et al. 2006; < 200 Mt y^{-1} for Huanghe, Wang et al. 2007).

Moreover, such island-wide high erosion might have

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