Seabed signatures of gravity flows on subaqueous deltas: recent observations

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Rivers that create deltas typically transport large amounts of sediment and have significant vertical relief (e.g., delta-front and foreset regions). These two factors can lead to development of turbid flows with large concentrations of suspended sediment fluid-mud and hyperpycnal flows. Both are important because they transport large amounts of sediment. On broad continental shelves, the flows are responsible for developing morphologic features (e.g., subaqueous deltas, clinoforms), and on narrow shelves they can transport sediment beyond the shelf break. Because the flows have large amounts of sediment, they can dominate the flux of sediment across deltas. The flows also move under the force of gravity and follow different trajectories than sediment transported by physical motions of seawater (e.g., currents and waves). Recent research on deltas has provided knowledge about gravity flows and the resultant signatures recorded in the seabed (e.g., sedimentary structures, radioisotope profiles).

Studies associated with rivers discharging to broad shelves provide insights that are relevant to sediment dispersal associated with large Chinese fluvial systems (Changjiang, Huanghe). On the Amazon continental shelf, energetic tidal and wind-generated currents and waves put much sediment into suspension, and estuarine-like convergent transport creates localized concentrations of suspended sediment that flow from topset to foreset regions as fluid muds (>10 g/l) and cause aggradation and progradation of a clinoform structure. Studies in the Gulf of Papua document the occurrence of similar fluid-mud flows, and delineate the spatial variability of the flows across the clinoform in some cases due to the locations where physical processes focus suspended sediment on the topset, and in other cases where morphologic features (shelf valleys) focus flows on the foreset.

Studies associated with rivers discharging to narrow shelves provide insights that are relevant to the mechanistic operation of gravity flows associated with large Chinese fluvial systems. Intense wave activity can create large concentrations of suspended sediment within a relatively thin boundary layer (cm to tens of cm thick). These turbid waters can then flow down bathymetric gradients, as long as the wave activity keeps the sediment suspended. Such mechanisms have been observed in association with the Eel and Po Rivers. In the former case, most of the sediment discharged is carried to the continental slope (including an adjacent submarine canyon), and in the latter case, much sediment moves to the foreset of the subaqueous delta. In some unusual cases (e.g., river floods), large concentrations of suspended sediment (>40 g/l) may enter the ocean directly (i.e., with freshwater) and flow under the control of gravity. These are more difficult to document, but some studies may be able to demonstrate their existence (associated with the Rhone, Sepik, and Eel Rivers).

Vulnerability assessment of deltas of the Asian monsoonal region

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Low-lying deltaic coasts are widely recognised to be experiencing coastal erosion and inundation along their ocean margins. The densely populated megadeltas of the Asian monsoonal region are also undergoing rapid changes as a result of human modification of land use both in the catchment and across the coastal plains, including water extraction and diversion. Global climate change presents an additional threat that will make the management of these dynamic systems increasingly difficult.

The potential impacts to which individual megadeltas are exposed are related to the climate drivers and the way in which they are changing, and the susceptibility of different sections of a delta is a function of the geomorphology of the shoreline and the delta distributaries. The adaptive capacity of the population in each delta is relatively low, rendering large numbers of people vulnerable, as tragically demonstrated during Cyclone Nargis. The threat is accentuated as a result of local factors including crustal