Gravity Flows At The Mouth Of The Fly River

Award: 02-03351 (July 2002) and 05-04616 (August 2005)

C. Nittrouer[1], A. Ogston[1]

[1]*University of Washington*

Subaqueous-delta clinoforms are accretionary features created on the continental shelf where there is a large supply of sediment. Sediment is transported across the shallow topset region, and accumulates rapidly in the deeper foreset region. In the Gulf of Papua, Papua New Guinea, the absence of cyclonic storms makes tidal currents and seasonal variation of wind direction primary controls on the timing and magnitude of across-shelf sediment transport. To investigate processes that disperse sediment across the topset of the Fly River clinoform, anchor stations were occupied during spring and neap tidal cycles of the trade-wind season, the monsoon season, and the transition period. During the energetic trade-wind season, surface waves coupled to strong spring-tide currents generated peaks in suspended-sediment concentration (>100 g/l at some locations). However, seabed erosion and deposition over tidal time scales could not be discerned, indicating that sediment was being advected across the outer topset. Although seaward gravity flows occur with significant spatial heterogeneity, they are important for carrying sediment to the foreset region, because the nearbed circulation generally has a landward net flow. Seaward transport is restricted to the energetic trade-wind season. During the quiescent monsoon season, 4-11 cm of erosion occurs on parts of the outer topset as fluvial sediment is temporarily deposited closer to shore. Seasonal patterns in sediment dispersal are likely impacted by El Niño-Southern Oscillation, and consideration of El Niño conditions of 2002-2003 are reflected in the interpretation of observations.

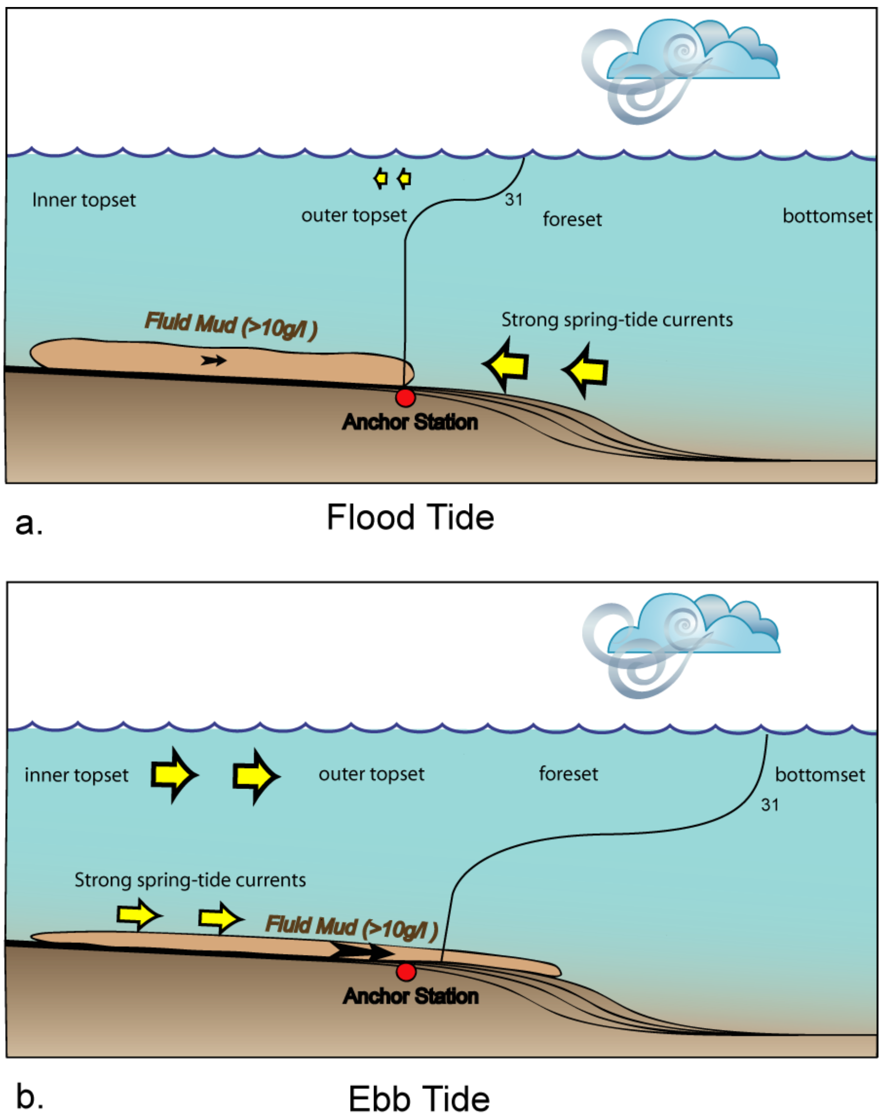

Figure: Schematic of fluid-mud formation within Umuda shelf valley during (a) spring flood tide and (b) spring ebb tide of the trade-wind season. Strong tidal currents act in concert with waves to resuspend and advect sediment derived from the Fly River delta and the inner topset (31 salinity contour is shown). During flood tides, fluid-mud gravity flows grow in thickness (to a maximum of ~130 cm) and in concentration (>100 g/l) as their downslope flow is impeded by shoreward currents (a local convergence mechanism). During ebb tides, downslope transport of fluid mud is assisted by seaward currents, and flows only reach a thickness of ~60 cm.

D.P. Martin, C.A. Nittrouer, A.S. Ogston and J.S. Crockett, 2008, Tidal and seasonal dynamics of a muddy inner-shelf environment, Gulf of Papua, Jour. Geophys. Res., 113, F01S07, doi:10.1029/2006JF000681.