Erosion and Transport of Suspended Sediment Near the Po River Delta, Northern Adriatic Sea.

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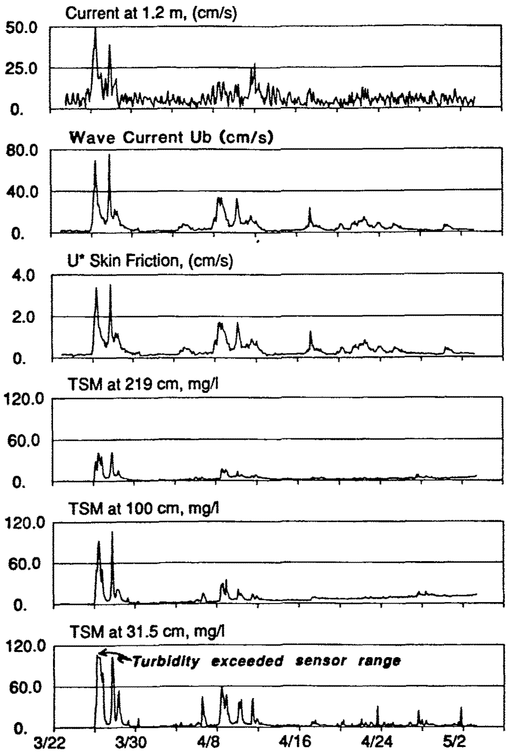
During the 41-day period from 22 March 1990 to 2 May 1990, an instrumented bottom tripod (GEOPROBE) and two sediment traps, at 2 m and 10 m above the seafloor, were deployed about 8.5 km off the Po River delta in 22.5 m water depth. This experiment was part of a cooperative project between the Istituto di Geologia Marina (Italy) and the U. S. Geological Survey (USA) to investigate the erosion and transport of sediment and pollutants on the inner continental shelf in this region. The GEOPROBE data, discussed in detail separately by CACCHIONE *et al.*, included time-series measurements of horizontal current velocity at three levels above the bed, near-bottom pressure and temperature, light transmission at three levels and optical backscatter at four levels. Bottom photographs were taken every 4 hours with a 35 mm camera-strobe system. Bottom sediment samples collected by divers are principally composed of terrigenous silt and clay with less then 10% sand; mean diameters are 5-8 μm.

Although winds were light and variable for most of the deployment, two storms of moderate intensity transited the northern Adriatic on 23-25 March and 11-12 April. Currents and waves, which were weak during the non-storm periods, increased significantly during the storms and generated combined bed shear stresses as large as 12 dynes/cm^2 at the GEOPROBE site (see figure 1). The oscillatory currents produced by the surface waves made the major contribution to the elevated bed shear stress. The bed stresses during the storms were well above the erosion threshold (about 1 dyne/cm^2) for the local sediment, as shown by the rapid increases in suspended sediment detected by the optical sensors.

Suspended sediment concentrations at 7 levels within the bottom 2.2 m of the water column were estimated from the GEOPROBE optical data using laboratory calibration curves developed specifically for the local bottom sediment. The results show that suspended particulate matter (SPM) concentrations during low energy conditions were of the order of 1-5 mgl^{-1} and the material was relatively uniformly distributed in the bottom boundary layer. In contrast, during the March storm, SPM concentrations increased to a maximum of >175 mgl^{-1} at 0.3 m above the bottom and there was a strong vertical decrease in SPM concentration with height above the bed (figure 1).

The observed vertical SPM decrease in a strongly turbulent flow (U_{*c} > 3 cm/s) suggests that the average settling velocity of the eroded sediment grains was equivalent to fine quartz sand (d = 0.01 cm). Since the local bed contains <10% sand, it is likely that the sediment was eroded as large clumps and aggregates during the storms. This hypothesis is also indicated by the rapid decrease in SPM concentrations after the storm waves began to diminish.

The combined-flow bottom boundary layer model of Glenn and Grant (1987) was used to predict flow characteristics and SPM concentrations during the storm periods. Using the *disaggregated* grain size distribution of the local bed sediment as input, the model-derived estimates of the SPM concentration at z = 0.3 m were within 50% of the measured concentration. However, the model predicted nearly uniform concentrations owing to the small mean grain size. Accurate predictions of sediment transport in regions of fine-grained and cohesive beds will require knowledge of the sizes and densities of the particles in suspension.



REFERENCES

GLENN S.M. and GRANT W.D., 1987. - A suspended sediment stratification correction for combined wave and current flows. *J. Geophys. Res.*, 92, 8244-8264