

zone. In some cases, e.g. in the long navigation channel through the Maracaibo estuary in Venezuela (Partheniades, 1971) and in Zeebrugge harbor, Belgium⁴, the present source of fine sediment is marine rather than alluvial.

Fine sediment transport in estuaries is a complex process involving a strong coupling between tides, fresh water flow and the coagulated sediment. This process has been described extensively elsewhere (Postma, 1967; Krone, 1972). In Fig. 10.2, a schematic description is given. The case considered is one in which the estuary is stratified, and a stationary saline wedge is formed. Various phases of suspended fine sediment transport are shown on a tide-averaged basis. In a partially mixed estuary, the description must be modified, but since relatively steep vertical density gradients are usually present even in this case, the sediment transport processes are qualitatively similar.

With reference to this figure, the vertical variation of the horizontal residual flows (tide-averaged flows) can be conveniently described by computing the ebb predominance factor, EPF, defined as

$$EPF = \frac{\int_0^{T_E} u(z,t)dt}{\int_0^{T_E} u(z,t)dt + \int_{T_E}^{T_E+T_F} u(z,t)dt} \quad (10.3)$$

where $u(z,t)$ = instantaneous longitudinal current velocity at an elevation z above the bed, T_E = ebb period, T_F = flood period and $T = T_E + T_F$, where T = tidal period (Simmons, 1965). If the strengths of flood and ebb were the same throughout the water column, EPF would be equal to 0.5 over the entire depth of flow. This is almost never the case; EPF is usually less than 0.5 near the bottom, particularly in the saline wedge, and greater than 0.5 in the upper layers. The residual upstream bottom current is due to the characteristic nature of flow circulation induced by the presence of the wedge, which means that the strength of this current will decrease as the limit of seawater intrusion is approached, and is theoretically zero at the limit (node)

⁴Robert Kirby, Ravensrodd Consultants Ltd., Taunton, United Kingdom, personal communication.