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Soft-sediments deformations in tidal cross-stratified deposits - triggering mechanisms in the Early Pleistocene Catanzaro strait-fill succession, Calabrian Arc (Southern Italy)

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The Early-Pleistocene Catanzaro strait-fill succession consists of large-scale tidal cross strata-sets, accumulated in a tectonically-confined basin during a rapid phase of transgression. They range in thickness from 10 m along the basin margins, up to 35 m across the basin centre. Laterally and upwards, the tidal sandbodies pass into highly bioturbated fine sandstone and siltstones.

Soft-sediment deformations were diffusely detected in many of these tidal cross strata. These structures mostly consist of: (i) buckled foreset, which characterize the thickest cross strata and (ii) folded foresets resulting in overturned cross-strata, which were observed in the thinner cross strata. (i) Buckled foresets are marked by the presence of folds, differing in shape and size. Generally, the largest and most folded complex occurs in the upper part of the bed. Downwards, the amount of deformation progressively decreases, the folds being simpler in the geometry and smaller in dimension. Folded cross-sets are truncated by the overlying undeformed cross-set. (ii) In the folded foresets, the deformation is restricted to individual sets, and does not affect the underlying or overlying strata. Deformation is generally regular, i.e. the lower part of the set has a normal angle of foreset dip, but higher up the foreset gradually steepens and overturns to form a recumbent fold. In the observed cases, overturning is always toward the dip direction of undeformed cross-beds within the same set. Folded cross beds occur within a restricted part of each set, and the intensity of deformation decreases in upstream and downstream directions so that the deformed strata pass in both up and down palaeocurrent directions into undeformed cross-strata. An essential feature of the disturbance is that cross strata are overturned into complex folding without accompanying fractures. Throughout each folding, the laminae remain parallel to one another, and in most instances, the basal portions is undeformed.

Since primary lamination is generally still recognizable, deformation mechanism seems to be related to liquefaction processes with localized water-escape features (associated with homogenized sediments). The discussion of possible origin of these deformation mechanisms has been carried out taking into account also the data coming from the facies analysis. Soft-sediment deformation structures occur at specific stratigraphic positions and stages of the vertical evolution of the tidal cross-stratified deposits. That implies a probable autogenic trigger mechanism: in fact, allogenic processes (like earthquakes or tsunamis) should affect the analyzed deposits with a vertical occurrence that is not related with a specific facies. The possible autigenic trigger mechanisms that have an ordinary occurrence in this sedimentary environment can be summarized as follow: collapse of foresets related with shear stress exerted by tidal currents, overloading induced by the rapid migration of traction deposits on a soft-sediment substrate, unequal loading related with the complex morphology of the water-sediment interface. Therefore, the regular vertical occurrence of soft-sediment deformation structures can be related also with the relative sea-level changes.