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A New Process Model for Turbidity Current Mudwaves (Sediment Waves) : Evidence from Toyama Deep-Sea Channel Levees, Japan Sea

Mudwaves are large-scale sediment waves known from the levees of submarine channels, as well as from abyssal plains and continental slopes. In spite of the common occurrence of mudwaves on the deep-sea floor, their origin have been controversial for the last thirty years due to the insufficient evidence. A new process model for turbidity current mudwaves can be proposed here, based on the detailed investigation of the mudwave fields on the levees of the Toyama deep-sea channel. The present data constitute abundant sediment core samples from stoss and lee slopes of the mudwaves, high resolution (3.5kHz) echo-sounding and single-channel airgun seismic reflection profiles. These data allow to reveal 3-D anatomy of the mudwave fields.

A layer-by-layer correlation of the deposits across the mudwaves shows that the turbidites are markedly thicker (~twenty times) on the stoss sides of the mudwaves, which reflects differential accretion and has resulted in retrogradational climbing of the aggrading mudwaves. The stoss sides have apparently acted as sites of flow deceleration, whereas the lee slopes have accelerated the flow and often promoted sediment bypassing. Seismic reflection profiles show that the mudwaves have been instigated by pre-existing large sand dunes that are up to 30m thick and were created by spillover turbidity currents with estimated thicknesses of the order of 500m and velocities of 1-10m/s at the initial phase of the levee development. The differential draping of the sand dunes by subsequent spillover turbidity currents, with a finer-grained load and estimated velocities of <35cm/s, is thought to have instigated the development of the mudwaves.

Although mudwaves are chiefly composed of muddy sediments, the present model predicts the large substratum sand dune fields that would be a potential reservoir.