Bedform-velocity matrix: the estimation of deep bottom current velocity from bedform observations

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Abstract: *This paper reviews the variety of depositional and erosional bedforms that result from bottom current influence on the seafloor. We present a new bedform-velocity matrix that links bedform type and sediment grain-size to bottom current velocity.*

Key words: *bottom current velocity, bedforms, seafloor sediment.*

INTRODUCTION

The impact of bottom (contour) currents in shaping the deep seafloor is well known. Long-term erosion creates widespread hiatuses and other erosive features, whereas extensive deposition leads to the construction of contourite drifts (Stow *et al*., 2008). The seafloor beneath deepwater bottom currents is characterized by a wealth of erosional and depositional bedforms that can provide valuable information about flow direction, strength, variability and continuity.

This work synthesized both our own and published data in order to present (Stow *et al*., 2009): (1) a preliminary database of deep water bedforms; (2) quantification of the associated flow velocity; and (3) a new *bedform velocity matrix* , which facilitates the estimation of deep bottom current velocity based on bedform type. We also comment on some of the implications for understanding the fundamental processes involved.

BEDFORM-VELOCITY MATRIX

Surface lineation, crag and tail structures and small ripples require only a few hours to form, at most, but their very common occurrence in bottom photographs and their persistence over repeated photo-transects, reflects long-term mean velocity, at least in some cases.

Larger ripples, dunes and sandwaves take relatively longer to form, and so reflect persistent higher velocity currents over a period of several hours to days, or even weeks for larger sandwaves. These larger bedforms are commonly covered by smaller ripples and lineation, which suggests , which facilitates the estimation of deep bottom current velocity based on bedform type intermittent high-velocity episodes, perhaps related to tidally enhanced flow, benthic storms, or other events of sufficient duration to allow their construction.

Still larger-scale depositional bedforms, such as sand and gravel ribbons, and erosional features, including furrows and comet scours, require a longer period of formation, although whether this is days, months or years is not currently known. Almost certainly they form in regions prone to persistent high velocity currents, such as contourite channels and gateways, but the presence of smaller-scale ripples within some furrows indicates intervening periods of relative quiescence. Giant sediment waves, contourite drifts and contourite channels form over periods of thousands to a few million years and so reflect the long-term stability of low-velocity bottom currents (Stow *et al*., 2008, 2009).

Despite imperfections, we believe this bedform-velocity matrix (Fig. 1) to be a valuable model for assessing strength and variability of bottom currents, which can significantly influence the siting of submarine cables, pipelines and other seafloor installations.

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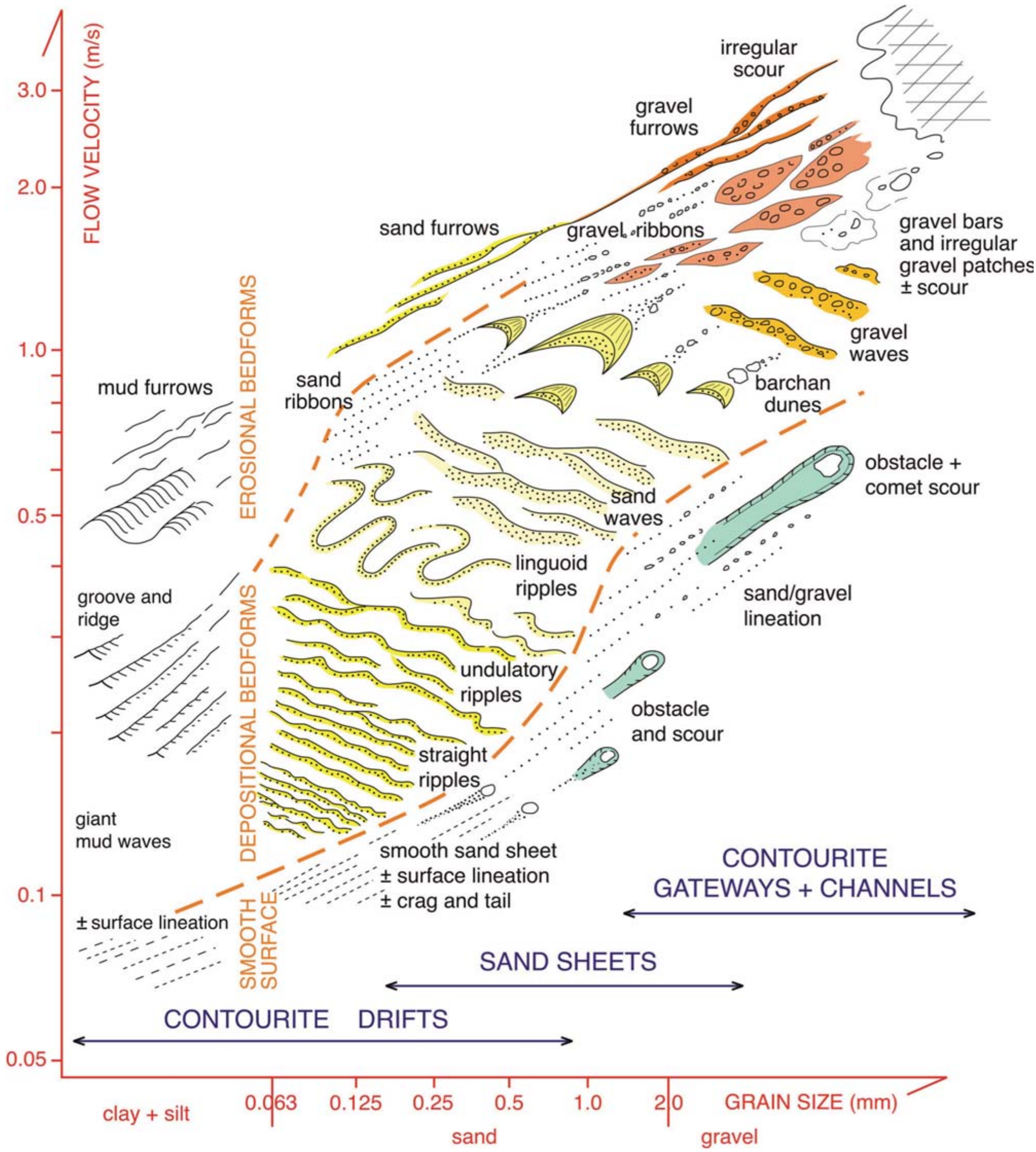

FIGURE 1. Bedform-Velocity Matrix (from Stow et al 2009).