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Wave and Tidal Current Sorting of Shelf Sediments Southwest of England (Summary Only) [and Discussion]

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Wave and tidal current sorting of shelf sediments southwest of England

(summary only)

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The relative roles of waves and tidal currents in sediment transport processes on the continental shelf off Lands End, southwest of England, are discussed in the light of (*a*) sediment grain size and boundary layer measurements in tidal currents, (*b*) regional variation in sediment parameters in relation to peak tidal and wave-induced currents, and (*c*) photographic and television observations of bedforms.

(*a*) The sediments in this temperate study area are mainly zoogenic sands. The size parameters have been determined by settling velocity in a specially developed sedimentation tower. The average median diameter of sediments from 144 stations is $d_{m,\phi} = 1.40_{\phi}$ (medium grade sand), with a standard deviation of 0.43_{ϕ}. The linear bottom current which will just move this range of particle size must attain a drag velocity (U_*) of 2.37 cm s^{-1}. This value is exceeded, only slightly, by the maximum drag velocity of 2.6 cm s^{-1} measured in a bottom tidal current in the area. Thus, tidal currents alone are just competent to move the sediments. This movement is intermittent and limited to certain states of the tide.

In contrast, wave-induced oscillatory currents during a force 10 (25 m s^{-1}) gale, reach a bottom water particle speed of 106 cm s^{-1} in every 50 wave trains (Hadley 1964) at a depth of 100 m, which is typical of the area. This water speed exceeds the threshold velocity for the sands occurring in the area. Even coarse sands can be moved 1 % of the time.

(*b*) The size of the median diameter of the sediments decreases, on a regional scale, southwestwards and northeastwards from south of the Lizard. This distribution of median diameter correlates well with the patterns of maximum tidal current speed.

The sediments are generally well sorted ($\sigma_i = 0.48_{\phi} \pm 0.11_{\phi}$). Sorting increases with decrease in depth, suggesting that wave induced currents exert the major control on sorting.

Silt and clay proportions increase westwards of the Scilly Isles and are influenced by both the weak wave-induced and tidal currents.

(*c*) Photographs and television pictures of the sea floor reveal bedforms of contrasting types. To the north of the Scilly Isles, especially in depths shallower than 80 m, bedforms are fashioned by oscillatory flows. Asymmetrical bedforms, however, are more common in the western English Channel, south of Lands End, where tidal currents are stronger. Farther to the west, at about 7½° W long., photographs show small scale wave oscillation ripples, in depths of 146 m.

Thus, movement of sediment by tidal currents occurs mainly in areas of high bed roughness and high tidal flow. These occur generally in the western English Channel rather than to the north of the Scilly Isles. Tidal current transport is intermittent but prolonged and appears to control the median grain size of the sediments.

Wave-induced currents are capable of moving appreciable amounts of sediment, especially

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during storms. Such currents are very intermittent but appear to control the sorting of the sediments. The well sorted sands of this area occur in depths of over 100 m. By analogy, many ancient, extensive, well sorted sand sheets may have been deposited at depths greater than previously suspected.

Discussion

V. N. D. Caston (*BP Co., Research Centre, Sunbury on Thames, Middlesex*)

Do you measure wave activity?

D. Hamilton

No, we do not make measurements of wave energy. The data used are those published by Hadley and Draper from long-term observations. There is no published data on boundary layer flow conditions and our research is directed towards making these observations.

V. N. D. Caston

Why is the area rich in carbonates – is it an especially highly productive area?

D. Hamilton

The main reason for the high content of organically derived carbonate debris is that there is a very low input of terriginous material to the area at the present time. This is consequent on the last rise in sea-level, which has produced a sediment starved shelf. In addition, it was demonstrated that the highest levels of organic content correspond quite closely with the areas of highest currents, so winnowing may also play a part. The vigorous current conditions of the western English Channel are certainly conducive to fairly high levels of organic productivity, but the organic debris is generally not diluted by terriginous material.

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