

showed was so crucial to the quality of profile classification. If this had been done, we feel sure he would have obtained the statistically significant differences between (1) concave no berm, (2) concave with berm, (3) linear no berm, and (4) linear with berm which we found (CALDWELL and WILLIAMS, 1985, Figure 6). This is why we stressed the care with which our results should be interpreted.

Nonetheless, we are sure that our presentation of a refined procedure for the discrimination of profile type is a valuable contribution to coastal science, and has relevance to both sand and gravel beach studies. We are dealing with a highly dynamic and complex system, which in relation to gravel beaches in particular is difficult to study at the most vital

times of process/response interaction (*i.e.* during incident wave action, especially during storms!). It is not surprising, therefore, that our analytical tools are still fairly crude. The step/bar/composite model proposed by Orford is no more elegant than that we propose, but is just another valid conceptual view of the beach system. The advantages it presents in terms of the enhanced function of berm position must be balanced against its non-inclusion of processes which determine variance in macro-configuration. However, what our work on beach profiles does suggest is the occurrence of important long-beach morphological response variations, which may be related to longshore energy harmonics. This clearly needs to be incorporated into any improved model of beach profile genesis.

REJOINER: Gravel Beach Profile Characterization and Discrimination

J.D. Orford

It is rare to be allowed a second bite at the 'discussion apple,' but CALDWELL and WILLIAMS (1986) make a number of points concerning my discussion of their paper on gravel beach profile analysis (CALDWELL and WILLIAMS, 1986, ORFORD, 1986) which require further development. These comments are expressed in the order in which they are raised by CALDWELL and WILLIAMS (1986).

The question of sediment scarcity on any beach depends on some form of definition and possible cause of the problem. To deny without evidence, that sediment scarcity exists on a specific beach is insufficient! I suggest that most gravel beaches in west/south Wales show degrees of sediment scarcity as witnessed, for example, by the failure of such beaches to show long term major regressive development associated with the contemporary sea-level stationarity. Some reasons for this occurrence were given in my original response. Clearly definition of sediment scarcity depends ultimately on the bugery notion of sediment input/output, regardless of whatever mechanisms are operating between these two states. In gross terms the lack of regional macro-scale gravel beach growth indicates beach equilibrium or stability at best, and sediment scarcity at worst. The latter state is reflected in the lack of convex gravel profiles and the high elevation (>3 m) above MHWS of gravel beach crests when only one beach ridge is present: two features that are

characteristic of many fringing gravel beaches along the Welsh coast.

Neil Caldwell and Alan Williams 'feel sure' that if I had used their graphical standardization procedure the results of the analysis would have been different. I can't say definitely that they are right or wrong on this point! I accept (indeed I made the point myself) that *a priori* nominal profile categorization could alter the discrimination outcome. In response to their point, I suggest that the lack of any significant step/bar profile discrimination using the integral method (ORFORD, 1986, Figure 3) is not caused by the lack of graphical profile transformation. I do not believe that a transformation is required to differentiate between step/bar profiles when (a) the wave and swash conditions prior to the profile measurement were available as grouping criteria, and (b) the effective range of active beach width and beach height had already been partially controlled by the use of tidal split and the standardization of beach volume (ORFORD, 1986, Figure 4). Lack of integral based discrimination of Llanrhystyd profiles is related to an indifferent index which does not adequately specify the variation in beach profile relief.

I see no evidence to suggest that the volume of the gravel beach berm is anything but proportionately small to the volume of the beach sediment prism as defined by the H x W method of SONU and

VAN BEEK (1971). Clearly the only way to make the berm volume larger in terms of variance source is to consider the beach profile in terms of deviation from some mean/median/characteristic profile. In a sense this is what the eigen value/vector method of profile analysis attempts, with the added bonus that distinctive development of upper and lower beach berms would probably show up as differing components of profile variation. I would accept with this technique that variable beach profile widths may need to be numerically standardized prior to eigen value/vector analysis. The integral and Q_s methods apportion the affect of volume change by berm accretion across the whole beach profile. Thus berm presence is desensitized by integral and Q_s analysis, despite the clear diagnostic indication of macro-beach process that berm position contains.

I would not contest the point that Caldwell and Williams make concerning the elegance of either the step/bar/composite profile model, or the integral model. However to say that the former model has 'non-inclusion of processes' is incorrect. The step/bar/composite profile model has implicit process assumptions concerning the balance of beachface fluid force asymmetry as a function of breaker type

and storm severity, a point which CALDWELL and WILLIAMS (1985, p.135) themselves recognize.

Clearly a number of problems and moot points concerning the optimum way to characterize gravel beach profiles remain. However as CALDWELL and WILLIAMS (1986) note, new approaches to analysis are always needed. If they work they open up log-jams, if they don't work they at least have an heuristic benefit. Either way our understanding of gravel beach dynamics and sedimentation are in sore need.

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REPORTS OF MEETINGS

INTERNATIONAL GEOLOGICAL CORRELATION PROGRAMME (IGCP)

Project No. 200:

Sea-Level Correlations and Applications

1985 Annual Report on Scientific Progress

Late Quaternary Sea-Level Changes: Measurement, Correlation & Future Applications

The 1985 annual meeting of IGCP-200 was held during the 5th International Coral Reef Congress (Tahiti, 27 May — 1 June 1985). This sea-level meeting was co-sponsored by the INQUA Commis-

sion on Shorelines, Neotectonics, and the Holocene, the Inter-Union Commission on the Lithosphere, and the IGU Commission on the Coastal Environment, and consisted of a Symposium, a Seminar, business meetings and field excursions.

With 29 papers presented, the Symposium "Late Quaternary and Present Sea-Level Changes: Magnitude, Causes, Future Applications" (Chairmen: D. Hopley and P.A. Pirazzoli), was the most attended of the nine symposia of the Congress. It displayed a fine balance between research on sea level, coral reef response and the use of data on land/sea interaction applied especially to tectonic interpretation.