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REPLY

Reply to: Dubois, R., 1993. The concept of shoreface profile of equilibrium: A critical review. *Journal of Coastal Research,* 9(1), 255–278.

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We would like to thank Dubois for his thoughtful review of our paper criticizing the concept of shoreface profile of equilibrium, especially as used in applied engineering. Dubois does not dispute any of our conclusions. His main criticism is that we have thrown the baby out with the bath by providing no guidance "towards a reconciliation between the equilibrium concept and its use." Our immediate response is that we believe the shoreface profile of equilibrium concept has *no* practical use. Dubois suggests that comparing the predicted (theoretical) equilibrium profile with the observed profile can serve as the basis for conceptual models that can lead to better understanding of shorefaces. Our point is that we should formulate our conceptual models on observed profiles and not on some uncalibrated theoretical shape that is an average of least square fits. Why persevere with the theoretical shoreface profile of equilibrium at all. We showed in our study that almost all of the fundamental assumptions behind the concept are seriously flawed:

- The assumption that all shoreface profile shapes can be predicted by knowing only the grain size, ignoring all other critical variables, is unreasonable.
- The assumption of the existence of a closure depth is invalid. Oceanographic and geologic studies indicate that a closure depth does not exist.
- Offshore bars are not included.
- The assumption that all sediment is moved by wave orbital interaction without mean currents ignores data to the contrary from the modern shoreface oceanography literature.
- The concept does not recognize the control of profile shape by underlying geology, probably the single most important control of shoreface profile in many locations.
- n in the equation $y = Ax^n$ is an average value. Raising a number to an average power does not result in an average answer.
- A in the equation is said to be related to grain size. This has not been proven, nor is there a physics based reasoning behind this assumption.

Thus, using the predicted equilibrium profile (as opposed to a conceptual model based on observed profiles) "as the ultimate reference profile to which all observed profiles can be compared," as Dubois suggests, is inappropriate. Of what value is a single reference profile for comparing a rock-held profile on North Carolina's Outer Banks with a widely varying sand-rich profile from Australia's Gold Coast, or with a mud-steepened profile from the Delmarva Peninsula. In addition, if our conceptual models do not match the real-world profile shapes, and if the processes assumed to occur in the models are not realistic, there is no point in wasting time trying to make them fit some purely mathematical chimera.

Even study of real profiles will not necessarily readily produce a meaningful least squares fit to any profile. One of us (Smith) has cabinets full of profile data taken over 20 years from the sand rich Gold Coast shoreface. Once 50 or so profiles have been obtained along a single profile line the beach width and water depth variabilities completely overpower a mean squares fit to any profiles. The same may be true for the U.S. Army Corps of Engineers Duck Pier profile data, although the Gold Coast envelopes of profile shapes are much broader than the Duck Pier envelopes (Figure 19, Pilkey *et al.*, 1993).

Dubois suggests that using predicted profiles for comparison purposes would be a step along the way to construction of "a general model of the coastal environment". This mode of thinking may be the reason why the concept of shoreface profiles of equilibrium became so detached from reality to begin with. Shorefaces are highly variable features both in terms of processes and composition. By the time you have assumed away enough processes and compositional differences to describe with a single equation, rock underlain, mud underlain, sand poor, sand rich, rocky coast, barrier island, high energy, low energy shorefaces in the same "general model," the model becomes uselessly generalized.

The time has come to re-evaluate our "general model" approach to quantifying behavior of sand for engineering purposes. Most numerical models used to predict sand behavior in engineering applications claim general applicability but our discussion of the shoreface profile of equilibrium offers a critical example of an underlying assumption of all the models that cannot be applied generally. Putting it another way, we should assume that all beaches are different and that numerical models applicable to a macrotidal, high wave energy, sand rich, barred shoreface should not be expected to be applicable on a microtidal, low wave energy shoreface strongly controlled by underlying geology.