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Discussion

Reply to the Comment on "Wave climate, sediment supply and the depth of the sand–mud transition: A global survey" by D.A. George and P.S. Hill [Marine Geology 254 (2008) 121–128]

D.A. George [a,*], P.S. Hill [b]

[a] Coastal and Marine Geology Program, United States Geological Survey, Santa Cruz, CA, USA
[b] Department of Oceanography, Dalhousie University, Halifax, Nova Scotia, Canada

A R T I C L E I N F O

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A B S T R A C T

An analysis of concepts presented by George and Hill [George, D.A., Hill, P.S., 2008. Wave climate, sediment supply and the depth of the sand–mud transition: A global survey. Marine Geology, 254, 121–128.] regarding the depth of the sand–mud transition (h_{SMT}) was performed by Guillén and Jiménez [Jorge Guillén and José A. Jiménez, Comment on "Wave climate, sediment supply and the depth of the sand–mud transition: A global survey" by D.A. George and P.S. Hill [Marine Geology 254 (2008) 121–128], Marine Geology, in press]. We are pleased that our proposed definition of the h_{SMT} was confirmed to be appropriate. We are encouraged that the authors agree that wave period and wave height should both be used to determine h_{SMT} as we demonstrated in our Eq. (1), which calculates the bed shear stress at h_{SMT}. More in-depth research should focus on characterizing the role of sediment supply in determining h_{SMT}.

Reply

Guillén and Jiménez (2009) executed an analysis of two of the three relationships presented in George and Hill (2008) with a large dataset offshore of the Ebro Delta, Spain. Using almost 400 surface sediment samples, they examined the definition of the sand–mud transition (SMT) and the simpler equation (Eq. (2)) to calculate the depth of the sand–mud transition (h_{SMT}) proposed by George and Hill (2008). With such a large dataset, they were able to confirm the functionality of the proposed SMT definition. However, they claim that Eq. (2) was not sufficient to determine h_{SMT} and developed an alternative equation that incorporated wave period into the calculation. Finally, the authors argue that the alternative equation they suggest eliminates inconsistencies in the methods of George and Hill (2008). We are delighted to have our proposed definitions and relationships scrutinized by these researchers and appreciate their efforts to advance this topic.

To remind readers, the proposed definition of the SMT is the demarcation where the geometric mean diameter (GMD) of surface sediment fines from >63 µm to <63 µm, or percent mud changes from <25% to >25%. If both parameters are available, then we suggest the default parameter be the one based on GMD. We based this definition on the correlation between small grain size and large mud content ($R^2=0.67$, $p<0.01$) for data from 14 systems on wave-dominated coastlines associated with a river system. In their comment, Guillén and Jiménez (2009) found a strong correlation between these two textural properties of $R^2=0.88$ for their Ebro dataset. After confirming the relationship, they applied the dual definition of the SMT to a dataset that is more extensive than the one we had at our disposal. Their assessment led to a shallower h_{SMT} of 12 m compared to our reported 30 m. We thank the authors for this updated and more accurate h_{SMT} for the Ebro shelf. Their Fig. 2 leaves little doubt of the efficacy of the SMT definition, and we encourage other researchers to further test the definition with their own datasets.

With respect to the authors' examination of Eq. (2) ($h_{SMT}=(18.5\pm10.8)\ H_{1/3}+(5.2\pm17.2)$, $H_{1/3}$ as significant wave height), we are encouraged that they agree incorporating wave period improves the relationship but are concerned that their approach may unnecessarily complicate the calculations. In our analysis we applied the approach taken by Dunbar and Barrett (2005) to use wave-induced shear stress (τ_w) as the primary method to determine h_{SMT}. This calculation of wave-induced stress uses both wave height and wave period as inputs. Therefore, our Eq. (1) ($h_{SMT}=(0.74\pm0.36)\ h_{\tau(0.08)}+(12.21\pm11.78)$, $h_{\tau(0.08)}$ as the depth where $\tau_w=0.08$ Pa) implicitly uses wave period to calculate bed shear stress. As we describe later, Eq. (2), which relies solely on $H_{1/3}$, is also a good predictor of h_{SMT} when wave period data are unavailable or unreliable. If wave period data are at a researcher's disposal, calculating wave-induced shear stress is relatively simple and

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* Corresponding author. Now at the California Ocean Protection Council, Oakland, CA, USA.
E-mail address: doug.george@gmail.com (D.A. George).

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will provide a more accurate estimate of h_{SMT} than the alternative equation proposed by Guillén and Jiménez (2009).

While the authors' attempt to improve the basic relationship between energy and h_{SMT} is valuable, we think more efforts should directed at the secondary parameters that we were unable to quantify successfully. As we highlight with our Fig. 6 and an accompanying discussion, three factors were considered that incorporate sediment supply, geography and the physical environment. We examined sediment load from a nearby river, distance to the shelf break, and bed slope at the h_{SMT} with the intention of adding another parameter to Eq. (1) or (2). The residuals for these parameters from Eq. (2) do not indicate clear correlations, but previous work by McCave (1972) and Stanley et al. (1983) suggest that energy alone cannot explain h_{SMT}. In the discussion, we note that our characterization of sediment supply may need to be more robust than sediment load from a nearby river. That opens the door for new research opportunities that could improve the calculation of h_{SMT}, and we encourage more investigation along that line of thought. The authors conclude with a strong suggestion to avoid further simplification, and we agree. The models we present explain the majority of variance in a globally-based relationship and may be enhanced with better characterization of the role of sediment supply.

We thank the authors for providing new analysis and *Marine Geology* for encouraging this muddy discussion.

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