

Interactive comment on “Rolling stones; fast weathering of olivine in shallow seas for cost-effective CO₂ capture and mitigation of global warming and ocean acidification” by R. D. Schuiling and P. L. de Boer

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We thank Bijma for his comments. The estimate that present-day CO₂ emissions are around 30 (- 60) times larger than natural emissions from volcanoes and limestone dissociation combined will be further specified, and references given. Indeed, the intuitive expectation is that olivine grains which are heavier (s.g. 3.27–3.37) than size-equivalent quartz grains (s.g. 2.65), would be buried, thus limiting their weathering. During an additional experiment in a recirculating flume, larger olivine grains were seen rolling over the smooth sand surface (Fig. 1). Coarser grains, relatively unhindered by

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surface microtopography may continue over the surface because of geometric mechanisms such as kinetic sieving by which small particles tend to infiltrate between the larger ones in a dilated granular dispersion. Such burial indeed is seen not to be the case in sediments with mixed grain sizes (Slingerland, 1977), especially not if flow stresses are sufficient to also transport the largest size fraction of the sediment (Komar, 1987). In practice entrainment equivalent size ratios of heavy to light minerals may be up to four times smaller than predicted by settling laws, and for sand gravel mixtures, larger sizes may – depending on the roughness of the bed – have lower critical velocities than smaller ones (Slingerland, 1977), as indeed was observed in the flume experiment where larger (2-5 mm) olivine grains kept rolling over smooth fine to medium-grained sand surfaces (Fig. 1). The estimate of the cost of transport is based on prices of dry bulk sea transport found on the internet.

References

Komar, P. D.: Selective grain entrainment by a current from a bed of mixed sizes; a reanalysis, *J Sediment Res*, 57, 203-211, 10.1306/212f8ae4-2b24-11d7-8648000102c1865d, 1987. Slingerland, R. L.: The effects of entrainment on the hydraulic equivalence relationships of light and heavy minerals in sands, *J Sediment Res*, 47, 753-770, 10.1306/212f7243-2b24-11d7-8648000102c1865d, 1977.

Fig. 1. Picture in down-current direction shows sand accumulating behind a narrow by-pass in an experiment in a recirculating flume. The larger grains rolling over the surface are 4 to 5 mm in diameter.

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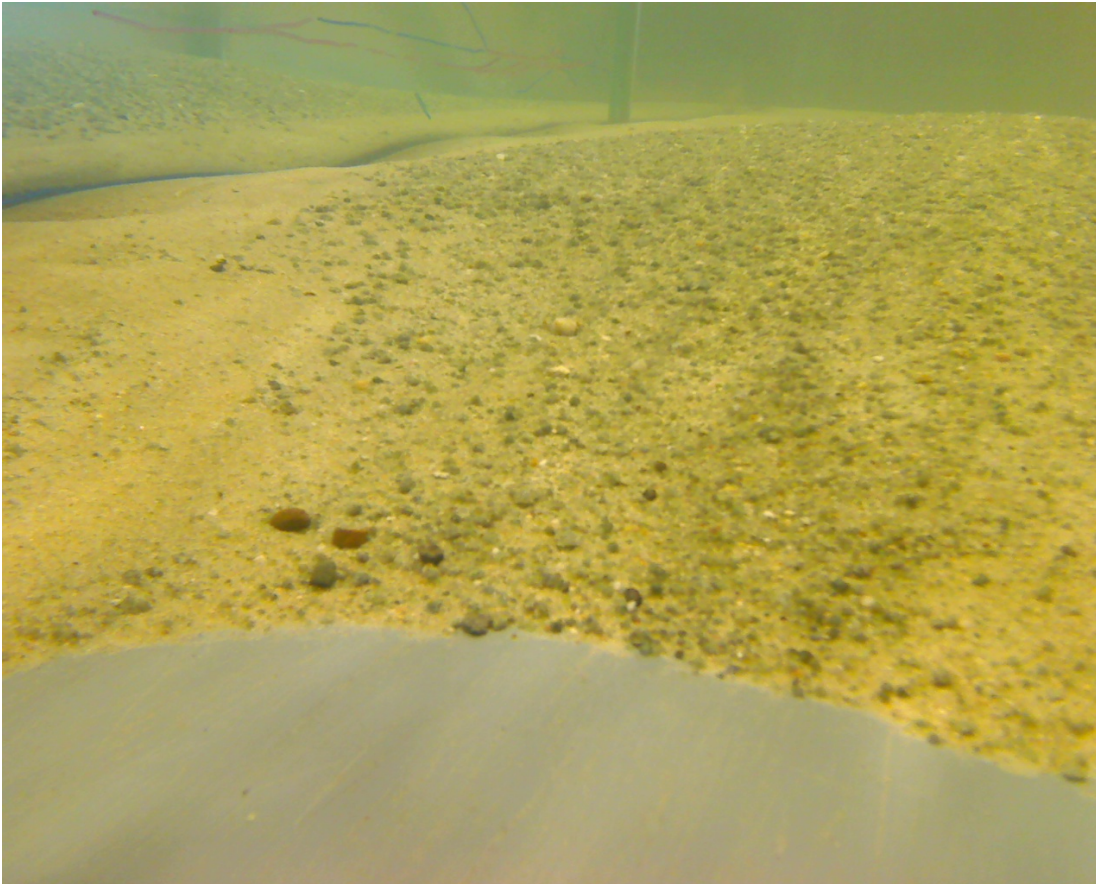


Fig. 1.

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