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Origin of giant wave ripples in Snowball Earth cap carbonate

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Grain diameter (mm)		Wavelength (m)			
Mean	***n***	**Mean**	**Range**	***n***	**Reference**
0.67	34	5.5	5 - 5.8	8	This study: Nuccaleena, Enorama Creek
0.87	31	2.6	1.8 - 3.2	7	This study: Nuccalenna, Elatina Creek
0.91	41	4.5	3 - 6	?	Halverson et al., 2004 Fig. 10b
0.43	3	0.6	?	?	de Alvarenga et al., 2004 Fig. 7b
1.28	25	2.5	2 - 3	?	Hoffman et al., 2007 Fig. 8b
1.86	8	1.5	1.2 - 1.8	?	Hoffman and Schrag, 2002 Fig. 4d
1.82	40	1.5	1.2 - 1.8	?	Hoffman and Schrag, 2002 Fig. 4b
1.99	10	1.0	0.5 - 1.5	?	James et al., 2001 Fig. 7b
0.63	31	1.0	0.5 - 1.5	?	James et al., 2001 Fig. 6a,c,d
0.12	?	2.6	1.5 - 3.5	4	Allen and Hoffman, 2005: Mackenzie Mtns.
0.5	?	4.3	3 - 5.4	3	Allen and Hoffman, 2005: Svalbard

Table DR1. Giant wave-ripple sediment sizes and wavelengths from this study and others (James et al., 2001; Hoffman and Schrag, 2002; de Alvarenga et al., 2004; Halverson et al., 2004; Allen and Hoffman, 2005; Hoffman et al., 2007). Wave ripple deposits analyzed are distributed globally (e.g., Hoffman and Li, 2009). *n* refers to the sample size. The wavelength range represents the maximum and minimum of reported wavelengths. Wavelength mean is calculated as the median of the range if *n* is unknown. The grain size measurements were made in cap carbonates that contain giant wave ripples, although in few cases are wavelengths reported systematically and paired with directly constituent grain size photomicrographs or reported statistics. We excluded studies where reported grain size sampling could not be confirmed to be from wave-ripple horizons (Kennedy, 1996; James et al., 2005; Jiang et al., 2006; Corkeron, 2007; Fairchild and Kennedy, 2007; Halverson et al., 2007; Nedelec et al., 2007). Measured diameters in the 2-D thin section for this study were corrected to represent 3-D particle diameters (Kong et al., 2005), and the mean diameter by mass was calculated from the resultant size distribution. Our particle size estimates are imperfect as they only count rare preserved grains (Fig. 2).

Figure DR1. – Examples of a giant trochoidal wave ripple from the Nuccaleena Formation, Australia.

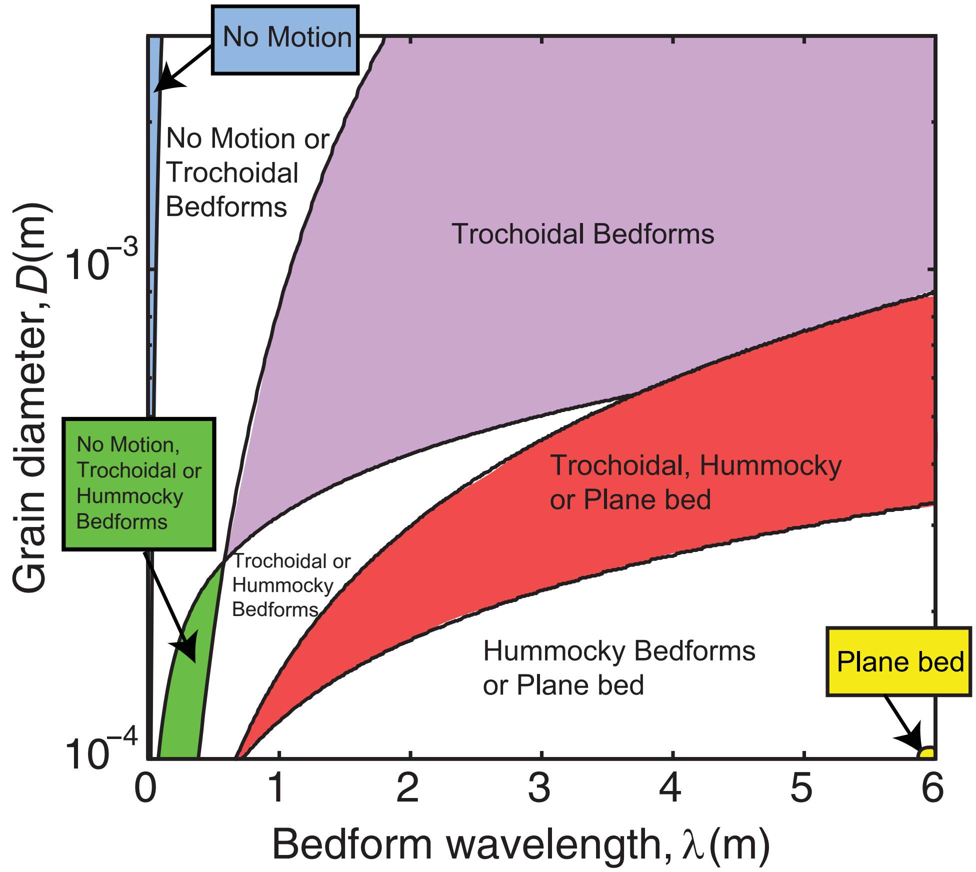

Figure DR2. Bedform stability diagram for linear pure oscillatory waves as a function grain diameter and bedform wavelength. This is the same as Fig. 1A in the manuscript, except here calculations are made assuming modern ocean conditions and siliciclastic sediment (water density = 1028 kg/m^3, water viscosity = 10^{-6} m^2/s and particle density is 2650 kg/m^3), rather than a warm ocean and carbonate grains. Changing these parameters has little effect on the stability boundaries. Ambiguity in the stability boundaries reflects uncertainty in the water depth ($1 < h < 100$ m) and wave climate assuming Airy wave theory and conditions for wave breaking and fetch-unlimited seas. See text for details on bedform stability criteria. Some bedforms (e.g., hummocks, plane bed) may occur outside of our solution space, for example, in the surf zone where waves are asymmetric and nonlinear. Source codes to reproduce this diagram with different inputs of densities, water viscosity, and water depths of interest can be obtained from the Data Repository.

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