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Applying Lofquist's (1978) Experiments to Geological Interpretation of Wave-Generated Ripples

Lofquist (1978) contains results of 104 experiments on the generation of ripples by oscillating flow over three quartz sands. By June 2001, at least 35 published articles, including 22 geological articles, had referred to this paper. Less than five made substantive use of it. For sands with D=0.18, 0.21, and 0.55mm, the critical orbital velocity to initiate sand motion on a flat bed depends on wave period, T. For ocean wave periods, all sands move at about 35cm/s. For 0.55mm sand, the critical velocity declines only slightly as T declines below 6s, but critical velocity for the finer sands declines rapidly to 20cm/s by T=3s, and is probably below 10cm/s by T=1s. Ripple wavelength is 4/3 of the half-orbit axis of wave-induced bottom water motion for low or moderate wave intensity, consistent with prior studies. Primary ripple crests in equilibrium during high wave intensity can pin the development of new ripple crests during waning wave action, forcing smaller secondary ripple crests into the troughs between primary crests. Such secondary crests have been reported many times: Darwin, 1884; Van Hise,1896; Kindle(several examples),1917; etc, and they are nicely shown on Plate 87B of Pettijohn and Potter (1964). The same pinning could allow depositional sequences of ripples that maintain verticle alignment of crests (Gilbert,1884), even while the waves vary. Finally, ripples start with a finite wave length and grow to equilibrium in a time somewhat greater than T x semi-major axis/D, which takes hours on the ocean and minutes on small lakes, in qualitative agreement with published data from Willapa Bay (Dingler and Clifton, 1984). Ripples in 0.55mm sand reach equilibrium significantly sooner than ripples in 0.18-0.21mm sands.