

Bioturbation and gutter casts – Implications for the origin of erosion and by-pass in storm-dominated carbonate systems

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Summary

The Terminal Carbonate Complex in the Las Negras area, Almería, SE Spain is a shallow-marine succession that accumulated after the Messinian Salinity Crisis characterized by abundant oolitic deposits and microbial carbonates. Detailed bed by bed facies analysis in the field and thin-section study in the laboratory reveal a wave dominated shallow marine depositional system by recognizing facies changing from foreshore, shoreface to offshore. The offshore is frequently affected by storm waves as indicated by interbedded sponge spicule wackestone and hummocky cross stratified ooid/peloid packstone. Gutter casts are commonly found below these hummocky cross stratified beds indicating erosion due to storm waves. *Thalassinoides* with a sharp wall penetrating from the base of gutter casts indicates an example of an autogenic firmground *Glossifungites* ichnofacies (e.g., Pemberton et al., 2004; MacEachern et al., 2007). There are two common mechanisms during storm waves accounting for the formation of gutter casts. One is strong offshore-directed unidirectional storm-surge relaxation flow (Myrow, 1992; Pérez-López, 2001; Grundvåg et al., 2021), whereas the other one is oscillatory flow or oscillatory component of the combined flow (Duke, 1990; Plint & Norris, 1991; Martel & Gibling, 1994; Varban & Plint, 2008). However, neither of these existing cut-and-fill mechanisms can explain the studied case because continued deposition from a decelerating flow immediately following erosion would have prevented bioturbation in the absence of a colonization window. The alternative explanation is that the initial strong storm waves caused erosion on the substrate forming the gutter casts and then burrows were produced during waning storms but before the strong backflow bringing sediments for deposition. Trace fossils, as an independent line of evidence combined with physical characteristics of sedimentary rocks, provide a new scenario for the formation of gutter casts and autogenic *Glossifungites*.

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