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The role of taphonomy in the palaeoenvironmental reconstruction of turbid-water coral reefs

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Reconstructing the taphonomic history of a fossil assemblage can provide a wide range of information concerning environmental conditions and ecological relationships of the living community including causes of death, biological and physical processes on the sediment surface, rates of transport, surface residence times before burial and diagenesis. Taphonomic analysis can ultimately reveal processes and patterns not readily recognizable by other palaeoecological or sedimentological approaches. As far as coral reefs are concerned, there has been the tendency to consider them as examples of preserved life assemblages. As a consequence, taphonomic approaches to the study of corals and coral reefs are relatively rare. Nevertheless, the development and demise of coral reef frameworks and the preservation potential of both in situ and rubble coral assemblages are strictly related to taphonomic processes such as, for example, physical disturbance (storm events and terrestrial run-off) and bioinfestation on both living and dead corals. Taphonomic signatures are especially significant in reconstructing environmental conditions associated to scleractinian-dominated turbid-water bioconstructions (TWBs) thriving in episodically or permanently turbid waters, where marine environmental parameters often approach the threshold levels for tropical carbonate production with respect to present-day classic reef models.

We present here a preliminary attempt of a taphonomic approach to nearshore-to deltaic turbid-water "reefs" (Eocene and Oligocene of Italy, Slovenia and Spain) using microfacies analysis, especially through identification of taphonomic signatures, as a tool to infer the incidence of controlling factors as hydrodynamic conditions, terrigenous input, light penetration and turbidity. Our analysis is particularly focused on primary processes occurring on coral remains before or during sedimentation, especially fragmentation and bioinfestation, including both bioerosion and encrustation. We highlight also that taphonomic features can ultimately be used for facies correlation in different stratigraphic sections, especially where a physical correlation is difficult.

We point out that for turbid-water bioconstructions the following typical taphonomic signatures can be identified: 1) encrustation and bioerosion are typically sparsely distributed among coral clasts and also within the same coral fragment; 2) bioerosion consists of a limited suite of traces; 3) the relative abundance of traces attributed to polychaete and sipunculid worms increases with respect to those attributed to clionid sponges, which are the most common borers in clear-water reefs; 4) surface residence time of coral rubble before burial is very variable and is probably the main factor controlling incidences of bioinfestation; 5) the degree of infestation by boring organisms is also dependent on coral morphology and skeletal architecture; 6) incidence of fragmentation is usually constant through the successions as a consequence of the commonly reduced reef zonation. We suggest finally that the variability of taphonomic features such as encrustation homogeneity, type and distribution of bioerosion traces can be used for turbid-water reefs to infer different degrees of sedimentation rates, accumulation vs suspension conditions, water turbulence.