Taphofacies Model for Coquina Sedimentation in Mero Field

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Abstract

Coquinas, bioaccumulations composed of shells and shell fragments, represent a significant portion of the sedimentary geological record but still lack detailed studies, particularly those addressing the unusual textural aspects that are challenging to interpret and integrate into various analytical techniques and scales of investigation. Among the coquinas, those found in the Itapema Formation (Barremian/Aptian, Santos Basin), of lacustrine origin, are of particular interest due to their substantial concentrations of hydrocarbons. The Mero oil field, in this context, stands out for its notable production, yielding 1,000 to 3,000 barrels of oil per day (bpd).

This study aims to classify the coquinas of the Itapema Formation based on taphonomic characteristics such as fragmentation and valve orientation, degree of packing, abrasion, rounding, classification and shell articulation.

Nine taphofacies (Tf-1 to Tf-9) were identified described as follow:

Tf-1 and Tf-3 corresponding to calcirrudites (grain size from four to seven mm) well-sorted, with chaotic orientation and high degree of shell fragmentation. Tf-2 is a calcirrudite (from four to seven mm) well-sorted in a concordant orientation, weak shell fragmentation and medium to coarse sandy matrix. Tf-4 to Tf-8 are a calcirrudite (grain size from seven to sixteen mm), in concordant orientation and moderate to high shell fragmentation. In Tf-5 and Tf-7 can be observed articulated shells preserved, not in live position. Tf-8 occurs rounded shell with no matrix associated. Tf-9 are a calcirrudite (grain size greater than sixteen mm) composed essencially by coquina lithoclast (silicified or not), shell fragments in chaotic orientation.

In general, the taphofacies present well to moderately sorted bioclasts, with loose to dense packing. Disarticulated, whole or fragmented bivalves occur in a concordant orientation, preserved by cementation and replacement by carbonates and/or silica, frequently associated with stylolites and compaction. Thin-section and tomography (CT and H-CT) analysis allowed the biofabric interpretation, highlighting normal and inverse gradation, plane-parallel orientation, bioerosions, butterfly valves, pore, and fracture fillings with carbonates and silica.

The taphofacies described indicate a reworked deposist from coquina (para- to allochthonous shell concentration). The parautochthonous (Tf-2, Tf-4, Tf-5, and Tf-7) deposits were transported only short distances within their habitat and are primarily observed with articulated shells, showing minimal shell fragmentation. Taphofacies (Tf-1, Tf-3, Tf-6 and Tf-8) are classified as allochthonous, formed by reworking and transport driven by the wave action. Tf-9 can also be considered allochthonous, but influenced by tectonic processes that occurred in the basin such as uplift, erosion and reworking (telogenesis).