

Coding the echinoid skeleton – a quasimetric description of complex taphonomic pathways

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Taphonomic pathways determine the contribution of organisms remains to the fossil record. Skeletons which experience strong taphonomic processes can either be filtered out before they become fossilized or are highly affected and thus potentially bias paleontological analyses. The echinoid test is a multi-element skeleton and features a variety of micro- and macrostructural surface characters such as tubercles, ambulacral pores, genital pores and variations in stereom morphology. Although all characters are exposed to the environment, stereom differentiation as well as the spatial character distribution on the test can result in a range of taphonomic alteration grades on a single specimen.

The present study is based on 1052 test of the minute clypeasteroid echinoid *Echinocyamus pusillus* from the Mediterranean Sea and is analyzed for fragmentation, encrustation as well as the abrasion of tubercles, stereom surface as well as genital- and ambulacral pores. The use of character coding including both taphonomic grades as well as spatial distributions of specific characters on the test results in a quasimetric and numerical description of taphonomic abrasion grades. These values can be handled as interval-scaled data thus enabling bi- and multivariate statistical analysis.

Results show that the Mediterranean *Echinocyamus* tests are generally well preserved; abrasion values are low, fragmentation and encrustation is rare. A comparison of the surface characters shows that abrasion grades of the tubercles are higher than that of the surface stereom or pore margins. Exposed tubercles show significantly higher abrasion grades than sheltered tubercles of the peristomal area. Analysis also indicate that abrasion values increase significantly with increasing encrustation levels, which can be due to the fact that incrusting organisms cross plate boundaries and thus strengthen the structural integrity of the echinoid tests.