The Deleterious Effects of Phosphates in the Preparation of Ostracode Shells

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ABSTRACT

Ostracodes continue to be the most useful group of Crustaceans in geological practice, but little attention has been directed to the consequences of preparation techniques and related implications for use in paleoenvironmental reconstruction and stratigraphy. Here, experiments and comparisons were applied to modern ostracodes from the upper continental shelves of Louisiana and Mexico and fossils from Pleistocene deposits of south Florida, Eocene sediments of Louisiana (Montgomery Landing, Grant Parish) and Cretaceous metamorphic rocks from northeastern Spain.

Common practice in shell preparation includes the use of sodium hexametaphosphate [$(NaPO_3)^n$] and/or sodium tripolyphosphate ($Na_5P_3O_{10}$), marketed in the U.S.A. in the product "Calgon Water Softener." Here, water from several sources (tap, bottled, and distilled) were each used with Calgon solutions of 0, 2.5, 5, 10, 15, and 20% by weight for periods of 1, 6, 12, and 24 hours. Also, individual ingredients in Calgon were separately tested with shells; these include: sodium metahexaphosphate, sodium tripolyphospate, sodium chloride, sodium bicarbonate, and sodium carbonate. None of the latter three had a deleterious effect of ostracode shells.

The phosphates caused a sequential degradation of the shells through dissolution. Furthermore, experiments using different concentrations of phosphates for various periods of time allowed the controlled exposure of structures usually not visible and therefore difficult to study. Careful monitoring of treatment time and the amount of phosphate can result in exposing features of interest and has the potential for revealing previously unknown structures. These dissolution experiments simulate some diagenetic processes in a predictable, sequential removal of the epicuticle and exposure of the inner layers of organic mesh. Muscle scars were clearly etched and floored bases of spines were exposed.

In exterior view, the epicuticle (EPI) undergoing dissolution first developed pits about 700 µm across. With further degradation, the spines appeared worn, pores enlarged 20 – 50%, and patches of EPI were lost. Dissolution exposed the exocuticle (EXO) with fine pits (1000 µm) and solution tracks, 1000 µm across; the EXO too was lost in patches. The pits formed between the mesh of the relatively insoluble organic net work. As the EXO continued to degrade, margins of the central muscle scars were etched and the scars were then dissolved, forming holes. Continued removal of the EXO revealed the endocuticle (END) with its coarser mesh and larger pits between fibers. This sequence was compatible with commonly accepted carapace models.

Taphonomy of ostracodes is often mentioned in the literature, but little is offered about specific consequences for the alteration of fossils. Information from these solution experiments was integrated with alteration features of fossils, including those from metamorphic rocks which provide real taphonomic sequences. Furthermore, recrystallization and pyritization destroy the lamellæ listed above; casts and molds do not retain the layers or pits. Secondary mineralization seen in fossil ostracodes is imposed on the shell surface as it existed at the time, that is, possibly on an already degraded surface. Therefore, it is possible to interpret specific taphonomic processes that altered ostracode shells and attain a concomitant appreciation of information loss.