Unravelling diagenetic features in Cretaceous brachiopod shells using a SEM and AFM methodology - comparisons with recent shells

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Recent representatives of one of the three subphyla of the phylum Brachiopoda (the rhynchonelliformea) were observed prior to comparisons with those of Cretaceous age. After recognition of their morphology, the details of the hierarchical organization of these low-Mg calcite bivalved shells, considered as biomaterials, are analysed through the process of biomineralization. Modifications intervene in the course of fossilisation allowing pointing out light or heavy modifications in these biomaterials.
Several methods were applied to approach these recent brachiopod shells: using the scanning electron microscopy (SEM) and the atomic force microscopy (AFM). These complementary approaches allow observations at the micro and nano levels because it is essential to see what is the original state of organization of the shell and what is changed after death and during burial in the sediment.
Using both SEM and AFM observations on mirror sections we highlighted diagenetic alterations both in two-layered shells (with a primary and a fibrous secondary layers) and in three-layered shells (with an additional tertiary prismatic/columnar layer) from the recent period and during cretaceous stages.
While the inorganic phase of the shell is in intimae relation with the organic phase, the consequence could be a disorganization of the shell cohesion if the organic phase is destroyed, or a strengthening through recrystallization. SEM observations allow observe fusion of fibres after disappearance of the organic matrix around them, but AFM observations allow reaching the behaviour of the nanoparticles that compose the fibres and prisms when the intracrystalline matrix disappears.
What is responsible of these alterations throughout the fossilization process? The answer lies in the more or less rapid burial in the sediment, but also and above all in the presence of microboring organisms (algae, fungi) as well as in the bacterial activity within the shells (the organic matrices being a convenient food supply).

Mots-Clés : Brachiopod shells, Cretaceous, Recent, Diagenetic modifications, AFM, SEM

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