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Nanostructure of biogenic aragonite: a study of otoliths and bivalve shells from a freshwater environment

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There are numerous similarities between the otolith (an acellular calcium carbonate aggregate in the inner ears of fishes) and the shells of freshwater bivalves. Since both grow during a lifetime of the individuals, and show small increments or growth zones (in daily or subdaily periods), they are excellent time-keepers. By this capability they provide information about both the life history of the individuals and the geochemical evolution of their environments (Schulz-Mirbach et al., 2018; Cerrato, 2000). Changes of major and trace elements between the different growth zones have been studied thoroughly, but structural features, particularly those of otoliths, are not well known. We used scanning and scanning transmission electron microscopy (SEM and STEM) to study oriented ion-milled sections of an otolith and samples of *Dreissena* shells from Lake Balaton, a large, shallow lake in Hungary. SEM observations confirm that the growth zones within the otolith are built up of small increments, and they have a radially asymmetric appearance, whereas STEM images show that the small increments are terminated by tiny holes. Selected-area electron diffraction (SAED) patterns and HRTEM images show that the aragonite material of both samples is highly defective, with dense arrays of planar defects occurring in distinct areas, and grains joining along low-angle boundaries (around 1°). In addition, areas with multiple (double and triple) periodicities along the [110]* directions occur in both samples. Based on these preliminary observations, nanostructural features could provide important details about the growth of biogenic aragonite and the structural properties of distinct growth zones.

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