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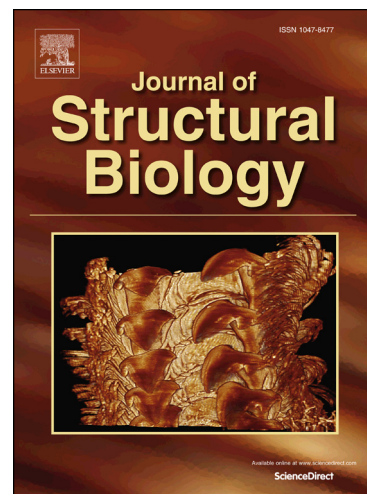
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**Elemental composition and ultrafine structure of the skeleton in shell-bearing protists  
—a case study of phaeodarians and radiolarians—**

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**Abstract**

Cross-sections were prepared by ultramicrotome (UM) and focused ion beam (FIB) system in order to examine the skeletal structure of ecologically and geologically important shell-bearing protists: phaeodarians and radiolarians. The elemental composition of the skeleton was clarified by the energy dispersive X-ray spectroscopy, suggesting that the skeletons of both groups are mainly made of amorphous silica ( $\text{SiO}_2 \cdot n\text{H}_2\text{O}$ ) with other minor elements (Na, Mg, Al, Cl, K, Ca and Fe) and that these two groups have similar elemental composition, compared with other siliceous organisms (diatoms and sponges). However, the structural difference among the two groups was confirmed: phaeodarian skeletons are porous, unlike radiolarians with solid skeletons. It was also revealed that the phaeodarian skeleton contains concentric layered structure with spaces, presumably related to the ontogenetic skeleton formation. The distinction in the skeletal ultrafine structure (porous/solid and non-dense/dense) would reflect the ecological difference among the two groups and could be an effective criterion to determine whether microfossils belong to Radiolaria or Phaeodaria. The UM and FIB combined method presented in this study could be a useful approach to

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