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The SEM and Spectral Analysis of Mineral Characteristics of Mussel Shell from Wocan-1 Hydrothermal Vent, Northwest Indian Ocean

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The Mussel organisms from the sulfide hydrothermal field of the mid-ocean ridge can virtually record the ecological environment information around the region. Previous works paid more attention to shells from freshwater (Yan and Zhang, 2011) and shallow sea (Peharda et al., 2021). Due to the scarcity of the collected samples, only the geochemical characteristics of mussels have been investigated by a few studies (Bau et al., 2010), while there are few reports on the internal microstructure, mineral compositions and genetic mechanism of the mussel shells. A mount of bio-specimens, including mussels, were firstly collected from Wocan-1 hydrothermal field in the Northwest Indian Ocean. These samples are excellent objective for exploring this issue. The mussels (*Bathymodiolus* sp.) of the hydrothermal field are explored by the SEM-EDS analysis, Laser Raman spectroscopy and Fourier transform infrared spectrum for their natural cross section morphology,element contents, and mineral component. The results show that the longitudinal growth of mussel shell includes periostracum, calcite prism layer, transition layer and slate lamella of aragonite from the outer to the inner(Figure1). The inner and outer layers of *Bathymodiolus* sp. are mainly composed of carbon, oxygen, calcium and a small amount of sodium and bromine. The contents of sodium and bromine, sourced from ambient seawater, in inner and outer layers were 0.6wt% and 0.3wt%, 0.3wt% and 0.2wt%, respectively. The carbon content of the outer shell (13.7wt%) was slightly higher than that of inner shell (12.5wt%). Conversely, the calcium content of the outer shell (34.2wt%) was lower than that of the inner shell (35.1wt%). Spectral analysis shows that the inner and outer layers of mussel shell are aragonite and calcite respectively, both of which are biogenic. The crystallinity of aragonite is slightly higher than that of calcite, and the organic component content of the aragonite layer is higher than that of the calcite layer.

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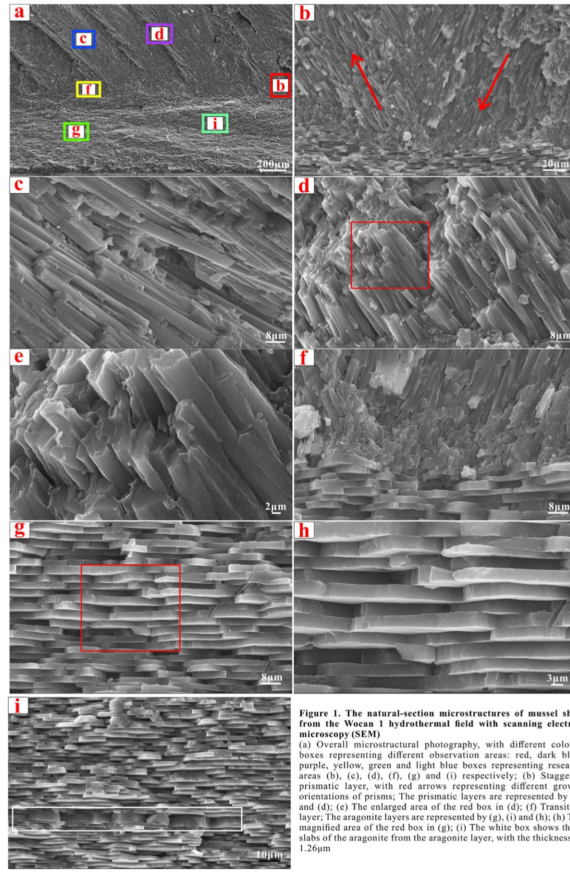

Figure 1. The natural-section microstructures of mussel shell from the Wocan 1 hydrothermal field with scanning electron microscopy (SEM)
(a) Overall microstructural photography, with different colored boxes representing different observation areas: red, dark blue, purple, yellow, green and light blue boxes representing research areas (b), (c), (d), (f), (g) and (i) respectively; (b) Staggered prismatic layer, with red arrows representing different growth orientations of prisms; The prismatic layers are represented by (c) and (d); (e) The enlarged area of the red box in (d); (f) Transition layer; The aragonite layers are represented by (g), (i) and (h); (h) The magnified area of the red box in (g); (i) The white box shows thick slabs of the aragonite from the aragonite layer, with the thickness of 1.26μm