

The formation process of axial internode skeletons in deep-sea isidid octocorals inferred from crystal orientation

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Isidid octocorals (Bamboo coral), which are cosmopolitan in distribution and occur to 4850 m in depth, have bamboo-like jointed axis consisting of elongated calcitic internodes with hollow structures in its center. These are joined by short nodes consisting of dark scleroproteins. The calcareous internode grows both vertically and horizontally, and show concentric growth layers in transverse section. To understand the formation process of their skeletons, previous studies have only focused the histology, cytology, and the observations using SEM. However, the hypotheses of the formation process are not consistent with each other.

The previous study suggested a rejuvenation near the center part of the calcareous internode by using radio carbon dating methods. The causes of the rejuvenation are considered (1) the changes of the age of water mass or (2) the secondary infilling of the hollow structure of internode (Farmer et al., 2015). On the other hand, the histological study of the precious red coral (*Corallium rubrum*) suggested that the formation of concentric layers of calcitic axial skeleton were secreted by skeletogenic epithelium on its outer surface (Grillo et al., 1993). Based on the histological study, the process of the infilling of the inner hollow part of axial skeleton may not be suitable for isidid octocorals.

To ascertain whether the infilling of the center part of internodes occurs in the isidid octocorals, we analyze the crystal orientation of the calcitic internodes. The different formation processes considered to makes different crystal structures. The isidid octocorals samples are collected by dredge during KH-10-7 from the Conrad Rise, Indian sector of the Southern Ocean. Our EBSD data of both the horizontal and vertical lines show that (1) the internodes are not composed by the fiber crystals but the very fine grains, (2) the directions of the c axis of the calcitic internodes are almost parallel to vertical growth line, (3) the crystal structure of the internodes is almost uniformed. These results support that the formation of the calcitic internodes occurs only on the outermost part of internodes by the skeletogenic epithelium. This clarification of the formation process makes the isidid octocorals available for paleoceanographic research.

Keywords: Deep-sea coral, Bamboo coral, Conrad Rise