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A fundamental function of calcareous spine of large benthic foraminifers for lighting inside

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Major groups of foraminifers precipitate calcium carbonate and form calcareous shells with unique and complicate structure. One characteristic structure is a spine, covering the exterior surface of the shells. These shells and spines are though to have a function for the protection of the cell from predators or for the prop to extend the pseudopodia. However, in other organisms (e.g., land plants), calcareous crystals play a role for increasing light intensity into the photosynthetic tissue more efficiency by scattering light. Our question is what are ecological functions of the shell and spines of calcareous crystals in foraminifers.

Large benthic foraminifers (e.g., *Calcarina*) are the dominant species in the tropical reef waters, where is under exposure of strong light with nutrient depletion. They harbor a vast amount of photosynthetic symbionts inside the cell and utilize these symbionts for uptake recycle-nutrients to survive in the oligotrophic waters. Morphologically, *Calcarina* have blunt spines, which help to spread the pseudopodia, extended in a single circle round a central axis. Their pseudopodia attach to the basement, and avoid to be flowed over by tidal wave. However, our knowledge to ecological function of calcareous spines of *Calcarina* is still limited. We investigated the crystal orientation of calcareous spines of *Calcarina gaudichaudii* by using Electron Back Scatter Diffraction (EBSD) analysis. Calcareous crystals are arranged horizontally to the axis of the spine in the center and gradually vent to the edge. This orientation of calcareous crystals makes a pathway of light through spines to the interior of the shell. Our finding suggests that calcareous spines of *C. gaudichaudii* have ecological function to focus light into the cell and promote photosynthesis of their harboring symbionts.

Keywords: Calcarina, calcareous, Electron Back Scatter Diffraction analysis