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A unique skeletal microstructure of the deep-sea micrabaciid scleractinian corals

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Structural and biogeochemical properties of the skeleton of many invertebrates rely on organic matrix-mediated biomineralization processes. Organic matrices, composed of complex assemblages of macromolecules (proteins, polysaccharides), may control nucleation, spatial delineation and organization of basic microstructural units. Biologically controlled mineralization is also suggested for the scleractinian corals whose different, molecularly recognized clades are supported by distinct types of skeletal microstructures. Main differences in scleractinian coral skeletal microstructures suggested so far consist in (1) varying spatial relationships between Rapid Accretion Deposits (RAD, "centers of calcification") and thickening deposits (TD, "fibers"), and (2) varying arrangements of biomineral fibers into higher order structures (e.g., bundles of fibers perpendicular to skeletal surfaces in some "caryophylliid" corals vs. scale-like units with fibers parallel to the surface in acroporiids). However, a common feature of biomineral fibers in corals described thus far was their similar crystallographic arrangement within larger meso-scale structures (bundles of fibers) and continuity between successive growth layers.

Herein we show that representatives of the deep-sea scleractinian family Micrabaciidae (genera: *Letepsammia*, *Rhombopsammia*, *Stephanophyllia*, *Leptopenus*) have thickening deposits composed of irregular meshwork of short (1-2 μm) and extremely thin (ca. 100-300 nm) fibers organized into small bundles (ca. 1-2 μm thick). Longer axes of fibers are aligned within individual bundles that, in turn, show rather irregular arrangement on the growing surfaces and within the skeleton (irregular criss-cross pattern). In contrast to other scleractinians (including deep-water "caryophylliids", fungiacyathids, and anthemiphyllids sympatric with micrabaciids), growth layers are not distinct. Also the regions of rapid accretion and thickening deposits are not clearly separated at the meso-scale. However, AFM and FESEM observations of RAD show nanogranular units (ca. 30-100 nm in diameter) typical of fast growing skeletal regions.

Unique microstructural organization of the micrabaciid skeleton supports their monophyletic status (reinforced by macromorphological and molecular data), and points to a diversity of organic matrix-mediated biomineralization strategies in Scleractinia.