Venus flower basket shrimp

Click/tap images for attribution and license information. The Edit GalleryVenus Flower Basket (Euplectella aspergillum) is a marine animal that lives anchored in the deep seabed near the Philippines. Looking more like delicate sculptures than animals, these tubular sea sponges usually stand 10-30 cm long and filter small food particles from the sea water as it flows through their bodies. Also known as glass sponges, their cylindrical skeletons are made of silica, the main component of glass. While glass is normally a brittle and fragile material, Venus flower basket skeleton is tough and stable because of its composition and how it is organized. There are at least six levels of organization in the skeleton that range from nanometer to centimeter in size. The glass skeleton of the fungus consists of spicules, tubule structures of concentric layers of amorphous hydrogenated silica separated by thin organic layers, like a Parisian pastry with just a tease of sweet cream between flaky crusts. But these thin organic layers go a long way to providing spicules with significant toughness. Even the pair of symbiotic shrimp that live their lives trapped in each Venus woven glass basket can not break out. Unlike biomineralization in other organisms such as abalone, the mineral portion does not seem to have a regular crystalline pattern. Experiments suggest that the silica layers consist of colloidal spheres of silica about 50 to 200 nm in diameter, which in turn consist of smaller spheres about 2.8 nanometers in diameter. By comparison, the smallest grains of sand on a beach (also usually silica) are about 60 nm in diameter. Each spicule consists of alternating layers of inorganic silica and organic compounds, all around a central protein filament. The inorganic bearings are made of hydrated silica nanoparticles and are relatively rigid. However, organic stocks appear to be weaker and able to absorb energy. This laminated organization of alternating rigid and weak layers can prevent cracks at the surface of a spicule from spreading deep into the nucleus. At a higher organizational level, spicules are arranged into a square lattice rolled up in a tube. This is the main shape of the glass sponge. Two separate but overlapping dithering forms the main frame, and since these dithering can still move relative to each other, the skeleton can be flexible as it grows. The grid squares are reinforced by struts running vertically, horizontally and diagonally. These struts are made of bundles of spicules and further support lattice against bending, sliding, and twisting forces. Spiral-shaped ridges of spicules are formed on the surface of the tubular structure and spiral around in opposite directions. These ridges also help the skeleton resist crushing or twisting forces. A cap at the top of the cylinder it from collapsing, while a flexible bundle of anchors spicules keep the entire skeleton attached to the seabed and able to withstand forces coming from the side. Finally, a silica matrix with small spicules embedded throughout cements the entire structure together and further increases strength. Each hierarchical level of organization in venus flower basket skeleton contributes to its overall mechanical performance. The result is a complex structure that is tough and stable even if its main ingredient is a naturally fragile material. To learn more about hierarchical structures in different living systems, check out the case study, Little Things Multiply Up: Hierarchical Structures in Zygote Quarterly 9: Edit Summary Despite its inherent mechanical fragility, silica is widely used as a skeletal material in a vast diversity of organisms ranging from silica and radiolaria to fungi and higher plants. In addition to their micro- and nanoscale structural regularity, many of these hard tissues form complex hierarchically ordered composites. One such example is found in the silica skeletal system of the Western Pacific hexactinellid fungus, Euplectella aspergillum. In this species, the skeleton consists of an elaborate cylindrical dithering structure with at least six hierarchical levels spanning the length scale from nanometer to centimeter. The basic building blocks are laminated skeletal elements (spicules) consisting of a central proteinaceous axial filament surrounded by alternating concentric domains of consolidated silica nanoparticles and organic intermediate layers. Two intersecting grids of non-planar crossform spicules define a locally quadrate, globally cylindrical skeletal lattice that provides the frame on which other skeletal constituents are deposited. The grilles are supported by bundles of spicules that form vertical, horizontal and diagonally ordered struts. The total cylindrical lattice is capped at its upper end by a terminal sight plate and rooted in the seabed at its base by a flexible cluster of tagged fibrillar anchor spicules. Externaldiagonally oriented spiral ridges extending perpendicular to the surface further strengthen the grille. A secondarily deposited laminated silica matrix that cements the structure together additionally amplifies the resulting skeletal mass. (Weaver et al. 2007:93) Edit References Churaumi Fish Encyclopedia Venus flower basket To Okinawa Churaumi Aquarium website Venus flower basket Group of Venus flower baskets Scientific classification Kingdom: Animalia Phylum: Porifera Class: Hexactinellida Order: Lyssacinosida Family: Euplectellidae Genus: Euplectella Species: E. aspergillum Binomial name Euplectella aspergillumOwen, 1841 Venus' flower basket (Euplectella aspergillum) is a glass sponge in fylum porifera. It is a marine sponge found in waters of the Pacific Ocean. Like other glass sponges, they build their skeletons out of silica, which is of great interest to materials science because they do not require heat to form their glass lattices, which in a way makes their properties superior to manufactured fiber optics. [1] [2] Like other fungi, they feed by filtering seawater to catch plankton. [3] The mushrooms are often found to house glass sponge prawns, usually a breeding pair, which usually cannot go out of the fungus's dithering due to its size. Consequently, they live in and around these mushrooms, where the prawns perform a mutualistic relationship with the fungus until they die. This may have influenced the adoption of the fungus as a symbol of immortal love in Japan, where the skeletons of these mushrooms are presented as wedding gifts. [4] [5] The presence of Venus flower baskets is found in a small area of the sea near the Philippine Islands. Similar species occur near Japan and other parts of the Western Pacific and Indian Oceans. Morphology Close-up on top of a basket basket basket at a depth of 2572 meters The body is tubular, curved and basket-like and consists of triaxon spicules. The body is perforated by many openings, which are not true ostia but simply parietal gaps. Syconoid type of ductsystem is present, where ostia communicate with incurrent channels, which communicate with radial channels through prosopyles which in turn open in to spongocoel and to the outside through osculum. The body structure of these animals is a thin-walled, cylindrical, vase-shaped tube with a large central atrium. The body consists entirely of silica in the form of 6-pointed siliceous spicules, which is why they are commonly known as glass sponges. The Spicules are composed of 3 perpendicular rays giving them 6 points. Spicules are microscopic, pin-like structures within the fungal tissues that provide structural support for the fungus. It is the combination of spicule forms in a fungal tissues that helps identify the species. In the case of glass sponges, the spicules weave together to form a very fine mesh that gives the body of the fungus a stiffness that is not found in other fungal species and allows glass fungi to survive at great depths in the water column. It is speculated that the fungus uses bioluminescence to attract plankton. [6] Applications The glassy fibers that attach the fungus to the seabed, 5–20 centimeters long and thin as human hair, are of interest to fiber opticresearchers. [7] [8] The fungus extracts silicic acid from seawater and converts it into silica, then forms it into an elaborate skeleton of glass fibers. Other fungi like the orange puffball sponge (Tethya aurantium) can also produce glass biologically. The current manufacturing process for optical fibers requires high temperatures and produces a brittle fiber. A process for creating and arranging such fibres, inspired by fungi, could offer more control over the optical properties of the fibres. These nanostructures are also potentially useful for creating more efficient solar cells at low cost. [9] Furthermore, its skeletal structure has inspired a new type of structural lattice with a higher strength-to-weight ratio than other diagonally reinforced square lattices used in engineering applications. [10] These fungi skeletons have complex geometric configurations, which have been studied extensively for their stiffness, yield strength, and minimal crack propagation. An aluminum tube (aluminum and glass has similar elastic modulus) of equal length, effective thickness, and radius, but homogeneously distributed, has 1/100th stiffness. [citation needed] References ^ ^ ^ ^ Schoepf, Verena; Ross, Claire (March 9, 2015). Perth Canyon: First Deep Exploration: A Deep-Sea Love Story. ^ ^ ^ McCall, William (August 20, 2003). Glassy mushrooms have better fiber optics than artificial ones. Ap. ^ Aizenberg, Joanna; Sundar, Vikram C.; Yablon, Andrew D.; Weaver, James C.; Chen, Gang (2004-03-09). Biological Glass Fibers: Correlation between optical and structural properties. 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