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Ancient ‘living fossil’ fish has scales that act as adaptable armour

Wrapped in adaptable armour
Getty

By **Chelsea Whyte**

The coelacanth fish is a living fossil, its appearance little changed in hundreds of millions of years. A new analysis of its scaly armour may reveal how it has stuck around for so long.

“Nature seems to generate combinations of properties that we have great difficulty with. I’m interested in how strong a material is and also how tough,” says Robert Ritchie at Lawrence Berkeley National Laboratory in California. “That combination is incompatible in synthetic materials, but nature does it with ease.”

fish because coelacanths are endangered.

Spiral staircase

When they CT scanned the scales, they found a surprisingly complex inner structure. On top is a tough mineral layer, and beneath there are bundles of collagen – the stuff that gives your skin its resilience – in a twisted structure similar to a spiral staircase.

When pressure is applied to the scales, as it would be when a predator bites a coelacanth, the energy is absorbed by the collagen bundles. These bundles respond by untangling and rotating in order to withstand more pressure. "It's like a smart material where the components of the structure are moving under load," says Ritchie.

The team also found that there are fibres between these bundles that play a role in stopping any cracks in the outer mineral layer from spreading. To see how they work, the team used a shark tooth attached to a mechanical arm to apply pressure to the coelacanth scale.

Tougher than glass

The scales have a toughness of around 5 megapascals per square metre. That's about 10 times tougher than window pane glass, Ritchie says, and relatively tough as far as biological materials go. What's more, the scales may have lost some of their toughness after 45 years in a museum collection, so the scales of living coelacanths might be tougher still.

that's created. It would be like trying to talk with toffee in your mouth," says Ritchie. After the puncture, the scales didn't see much reduction in strength, he adds.

Ritchie says this work could help us learn how to mimic natural armour, but it may be difficult to simulate. "Maybe 3D printing could attempt to mimic this in the future, but it's difficult to control the quality of material. Given a few decades, we'll probably get that right."

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