Microbes corrode steel in ships, marine infrastructure

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Rust is the bane of steel, whether on cars, on ships and boats, or as part of marine infrastructure. Now, contrary to previous thinking, it turns out that the ocean-dwelling, steel-corroding species, Mariprofundus sp. DIS-1, can thrive under aerobic conditions, rather than being limited to "micro-aerobic" or anaerobic conditions. That means steel in marine environments is more vulnerable to bacterial depredations than previously thought. The research is published on Friday, September 16th in *Applied and Environmental Microbiology*, a journal of the American Society for Microbiology.

"We followed up this initial finding by obtaining the genome sequence of strain DIS-1, and found that it possessed a suite of oxygen tolerance genes that are not found in other members of the Mariprofundus genus," explained corresponding author, Adam C. Mumford, PhD, who is currently a Mendenhall Fellow in the Eastern Branch of the National Research Program of the US Geological Survey.

"Going in, the goal of the project was to gain a clearer picture of how iron-oxidizing bacteria colonize steel in the marine environment," said Mumford, who performed the work in David Emerson's laboratory at the Bigelow Laboratory for Ocean Sciences, East Boothbay, ME. Heretofore, these bacteria had been studied only in jars, which had failed to fully simulate the dynamic ocean environment, said Mumford. To simulate a more natural ocean environment, Mumford designed a continuously flowing system. "We hoped this would give us a better sense of how the bacteria initially attached to, and colonized bare steel,"

he said. From there, using an imaging technique he developed, he was able to generate 3-D images of the process.

Earlier research had suggested that the corrosion was linked to sulfate-reducing bacteria, which are strictly anaerobic. That had led to a study which had used high throughput sequencing to show that iron-oxidizing bacteria where the initial colonizers, said Mumford, noting that these were largely replaced over time by other, often more corrosive bacteria. "We wanted to figure out how the initial colonization by iron oxidizing bacteria proceeded, and that question really drove the research," said Mumford.

The research is critical because microbially influenced corrosion is a leading cause of early failure of marine infrastructure, including bridges, pipelines, and port facilities, and is estimated to cost in the billions of dollars per year. "Understanding the basic microbiology of this process is a crucial part of figuring out how to mitigate it," said Mumford.

More information: Adam C. Mumford et al. Peeking under the Iron Curtain: Development of a microcosm for imaging colonization of steel surfaces bysp. DIS-1, an oxygen tolerant Fe-oxidizing bacterium, *Applied and Environmental Microbiology* (2016). DOI: 10.1128/AEM.01990-16

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