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Researchers at UH discover likely hemoglobin ancestor

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University of Hawaii researchers have made a breakthrough that could lead to the creation of substitutes for blood, according to UH microbiology professor Maqsudul Alam.

Alam said his research team discovered proteins containing oxygen in primitive microbes. The findings reveal what the climate was like on the planet earlier than 3.5 billion years ago when there was no oxygen. They also show how respiration may have evolved from there.

"We are very confident that this (protein) is the ancestor of human hemoglobin," Alam said.

Hemoglobin is the protein in blood that carries oxygen from the lungs to the body's organs. Hemoglobin probably was detoxifying dangerous gases and slowly evolved to transport and store oxygen for human life, Alam said.

"We believe, as we go, that similar proteins will be found in other tissues and also in microorganisms," he said.

The discovery was reported in the Proceedings of the National Academy of Sciences in an online "Early Edition" yesterday and will be in next Tuesday's print issue.

The lead author is Tracey Freitas, who has worked with Alam for about seven years and will graduate from UH with a master's degree this summer. Other team members are Shaobin Hou and Jennifer Saito in Alam's laboratory in the College of Natural Sciences, and James Newhouse, a computational chemist at the Maui High Performance Computing Center. University of Texas Southwestern Medical Center scientists also contributed to the

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The National Science Foundation said in announcing the discovery that diversity of life was able to expand with the ability to use oxygen for respiration, "an impact more fundamental, if perhaps not as dramatic, as the evolutionary transitions organisms made adapting from sea to land, from the ground to the air, or from 'all fours' to upright."

Freitas said it was believed that archaea, primitive single-celled organisms, would not have protein that could bind oxygen.

"We found this protein actually does exist and it has an effect on the evolution of oxygen-sensing in organisms," Freitas said.

Alam said his team theorized they would find hemoglobin in the protein of the "last universal common ancestor," from which all life evolved.

The primitive proteins, called protoglobins, were identified in two species of archaea.

Freitas said the textbook view was that oxygen levels rose in Earth's atmosphere and that proteins evolved.

"The contemporary viewpoint is (the last universal common ancestor) had these proteins already, and they could function in using oxygen to generate energy that maybe required a little bit of oxygen," Freitas said.

Now that they have identified the protein, Alam said, "We will know how the protein formed, what its property is and how we can modify and use it for different biological applications."

Alam said "intriguing connections" might exist between the "last universal common ancestor" and the evolution of mechanisms that sense oxygen, carbon monoxide, nitric oxide and hydrogen sulfide.