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PRESENTATIONS

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MONTANA STATE UNIVERSITY
Mountains & Minds

Department of Chemistry and Biochemistry

Doctor of Philosophy in Biochemistry

DISSERTATION DEFENSE

Mr. Stephen M. Keable

B.Sc. Montana State University, Bozeman, MT (2006)

Wednesday, December 7, 2016 – 9 am
Byker Auditorium
Department of Chemistry and Biochemistry

"Role of the P-Cluster and FeMo-Cofactors in Nitrogenase Catalysis"

Graduate Committee

Dr. John Peters (Chemistry, Research Advisor)
Dr. Joan Broderick (Chemistry)
Dr. Brian Bothner (Chemistry)
Dr. Martin Lawrence (Chemistry)
Dr. Tena Versland (Graduate School Representative)

ABSTRACT

Biological nitrogen fixation has been extensively researched for over four decades, yet due to the complex nature of this process, numerous questions still remain regarding the catalytic mechanism, and investigation of this system has relevance across a number of disciplines. Nitrogen is a fundamental element to all biological systems, primarily occurring in proteins and nucleic acids. However, most nitrogen on Earth is found in the form of nitrogen gas, a form that is biologically unavailable to most organisms owing to the strength of the triple bond between the two nitrogen atoms. The limited abundance of biologically accessible (or fixed) nitrogen has driven an anthropomorphic thrust to supplement the nitrogen cycle with nitrogenous fertilizers, thereby boosting agricultural output. The primary industrial method to produce these fertilizers, derived from the Haber-Bosch synthesis, is an energy intensive process that consumes approximately 1-2% of the world's energy portfolio. This process utilizes metal iron catalysis, high temperatures and high pressures, along with hydrogen usually obtained from reformed fossil fuels, to reduce atmospheric nitrogen gas to ammonia. Aside from the environmental consequences that arise from the production of nitrogenous fertilizers, long-term agricultural application may also have disastrous ecological ramifications, such as eutrophication. Additionally, biological nitrogen fixation supports more than half the human population, and having a more complete understanding of this complex process has the potential to displace some of the demand for fertilizer production. The aforementioned reasons are clearly enough to warrant serious investigation into biological nitrogen fixation, however, the fascinating intricacies and comparative relevance to other biochemical systems further motivates the study of this system. The enzyme committed to this task, nitrogenase, orchestrates an elegant unidirectional multiple electron reduction and activation of the nitrogen triple bond. Historically, mechanistic characterization of this enzyme has been difficult for a number of reasons; however, studies to date have revealed many aspects of the process as biochemical techniques have improved. Nitrogenase is an oxygen sensitive, complex two-component enzyme that is mechanistically pertinent to many other biochemical processes. . Presented here are studies revealing insight into substrate binding and the unique gated electron transfer mechanism of this fascinating enzyme.

BIOGRAPHICAL NOTES

Academic Preparation:

2000-2006 Montana State University, B.S in Biotechnology

Graduate Studies

Field of Study: Biochemistry

Teaching and Outreach Activities

2011 Introduction to Organic and Biochemistry, Chemistry 123, TA
2012 Introduction to Organic and Biochemistry, Chemistry 123, TA
2013 Astrobiology, Chemistry 350, TA
2013 Origins of Life, Philosophy 278, TA
2014 Astrobiology, Chemistry 350, TA
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2015 Astrobiology, Chemistry 350, TA
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Awards

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PUBLICATIONS

Sarma, R., Barney, B.M., Keable, S., Dean, D.R., Seefeldt, L.C., and J.W. Peters. (2010) Insights into substrate binding at FeMo-cofactor in nitrogenase from the structure of an alpha-70(Ile) MoFe protein variant. *J. Inorg. Biochem.* 104(4) 385-389

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