

# LANCE C. SEEFELDT

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Chemistry and Biochemistry, Utah State University, 0300 Old Main Hill, Logan, UT 84322

## EDUCATION

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- University of Georgia** *1989–1993*  
Postdoctoral Fellow, Biochemistry, Advisor: Leonard Mortenson  
Center for Metalloenzyme Studies
- University of California, Riverside** *1983–1989*  
Ph.D. Biochemistry, Advisor: Daniel Arp
- University of Redlands** *1979–1983*  
B.S. Chemistry, Magna Cum Laude

## RELEVANT EXPERIENCE

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- Professor** 2002 – present  
*Chemistry and Biochemistry, Utah State University* *Logan, UT*  
· Research on nitrogen fixation and mechanism of the enzyme nitrogenase. Supported by the US Department of Energy and NASA.
- Associate Professor** 1998–2002  
*Chemistry and Biochemistry, Utah State University* *Logan, UT*  
· Research elucidating the mechanism of the enzyme nitrogenase. Supported by the National Institutes of Health.
- Assistant Professor** 1993–1998  
*Chemistry and Biochemistry, Utah State University* *Logan, UT*  
· Electron transfer and ATP utilization by the enzyme nitrogenase. Supported by the National Science Foundation, the US Department of Agriculture, and the National Institutes of Health.
- Postdoctoral Fellow** 1989–1993  
*Center for Metalloenzymes Studies, University of Georgia* *Athens, GA*  
· Research on energy transduction in nitrogenase and hydrogenase.

## PROFESSIONAL SERVICE AND AWARDS

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- 2016 Workshop on Nitrogen Chemistry, Co-Chair, Council on Chemical Sciences, Geosciences and Biosciences, Department of Energy.
- 2015-2019 Council Member, Council on Chemical Sciences, Geosciences and Biosciences, Department of Energy.
- 2015 Co-Chair, N Cycle Workshop, National Science Foundation, Arlington Virginia.
- 2015-2019 Review Panel Member and Vice Chair, National Institutes of Health, Molecular Structure and Function A.
- 2013 Fellow, American Association for the Advancement of Science.
- 2012 NSF IDEAS Lab Mentor, Crewe England.

2012 Outstanding Lecturer Award, Pacific Northwest National Laboratory, Richland, WA.

2012 Department of Energy, Site Visit Review, Integrated Catalysis Sciences, Pacific Northwest National Laboratory, Richland, WA.

2012 D. Wynne Thorne Career Research Award, Utah State University.

2010 Science Collaborator of the Year, Energy Dynamics Laboratory, Utah State University.

2009 USDA Program Review Team Member for the Biochemistry Department at Virginia Tech.

2008 NIH, Molecular Structure and Function Study Section E, Ad hoc member.

2007 NIH, Molecular Structure and Function Study Section E, Ad hoc member.

2007 USU College of Science Teacher of the Year.

2005 NIH, Biochemistry and Biophysics of Membranes Study Section, Ad Hoc Member.

2005 USDA Plant Biochemistry Panel, panel member.

2004 USU College of Science Researcher of the Year.

2004 NIH, Physical Biochemistry Study Section, Ad Hoc Member.

2003 USDA Program Review Team Member for the Biochemistry Department at Virginia Tech.

2003-2006 Editorial Board Member, Applied and Environmental Microbiology.

2000-2002 Panel Member, NSF-Molecular Biochemistry.

2000 Chair, Gordon Research Conference, Nitrogen Fixation.

1999 Ad Hoc Panel Member, NIH-Metallobiochemistry Study Section.

1998 Ad Hoc Panel Member, NSF-Molecular Biochemistry.

1998 Vice Chair, Gordon Research Conference, Nitrogen Fixation.

2001-2003 Panel Member, USDA Plant Biochemistry Study Section.

1996, 1998 Panel Member, USDA, Nitrogen Fixation Section.

1992 Eli Lilly Travel Award Recipient, The Protein Society.

1988 President, Graduate Student Advisory Committee, Biochemistry Department, University of California, Riverside.

1987 Outstanding Teaching Assistant of the Year in Biochemistry, University of California, Riverside.

1983 Magna cum laude, University of Redlands.

1982 California Foundation for Biochemical Research Fellowship.

1982 President, American Chemical Society Student Affiliates, University of Redlands.

1979 American Legion Scholarship.

## **PUBLICATIONS – PEER REVIEWED**

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136. Pence, N., Tokmina-Lukaszewska, M., Yang, Z.-Y., Ledbetter, R. N., Seefeldt, L. C., Bothner, B., and Peters, J. W. (2017) Unraveling the interactions of the physiological reductant flavodoxin with the different conformations of the Fe protein in the nitrogenase cycle. *J. Biol. Chem.* (in press).

135. Khadka, N., Milton, R. D., Shaw, S., Lukoyanov, D., Dean, D. R., Minter, S. D., Rauegi, S., Hoffman, B. M., and Seefeldt, L. C. (2017) Mechanism of nitrogenase H<sub>2</sub> formation by metal-hydride protonation probed by mediated electrocatalysis and H/D isotope effects. *J. Am. Chem. Soc.* **139**, 13518-13524.
134. Ledbetter, R., Garcia-Costas, A. M., Lubner, C. E., Mulder, D. W., Tokmina-Lukaszewska, M., Artz, J. H., Patterson, A., Magnuson, T., Jay, Z. J., Duan, H. D., Miller, J., Plunkett, M. H., Hoben, J. P., Barney, B. M., Carlson, R. P., Miller, A.-F., Bothner, B., King, P. W., Peters, J. W., and Seefeldt, L. C. (2017) The electron bifurcating FixABCX protein complex from *Azotobacter vinelandii*: generation of low-potential reducing equivalents for nitrogenase catalysis. *Biochemistry* **56**, 4177-4190.
133. Paengnakorn, P., Ash, P., Shaw, S., Danyal, K., Chen, T., Dean, D., Seefeldt, L., and Vincent, K. (2017) Infrared spectroscopy of the nitrogenase MoFe protein under electrochemical control: potential-triggered CO binding. *Chem. Sci.* **8**, 1500-1505.
132. Lukoyanov, D., Khadka, N., Dean, D. R., Rauegi, S., Seefeldt, L. C., and Hoffman, B. M. (2017) Photoinduced reductive elimination of H<sub>2</sub> from the nitrogenase dihydride (Janus) state involves a FeMo-cofactor-H<sub>2</sub> intermediate. *Inorg. Chem.* **56**, 2233-2240.
131. Yang, Z.-Y., Ledbetter, R., Shaw, S., Pence, N., Tokmina-Lukaszewska, M., Eilers, B., Guo, Q., Pokhrel, N., Cash, V. L., Dean, D. R., Antony, E., Bothner, B., Peters, J. W., and Seefeldt, L. C. (2016) Evidence that the Pi release event is the rate-limiting step in the nitrogenase catalytic cycle. *Biochemistry* **55**, 3625-3635.
130. Milton, R. D., Abdellaoui, S., Khadka, N., Dean, D. R., Leech, D., Seefeldt, L. C., and Minter, S. D. (2016) Nitrogenase bioelectrocatalysis: heterogeneous ammonia and hydrogen production by MoFe protein. *Energy Environ. Sci.* **9**, 2550-2554.
129. Lukoyanov, D., Khadka, N., Yang, Z.-Y., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2016) Reversible photoinduced reductive elimination of H<sub>2</sub> from the nitrogenase dihydride state, the E<sub>4</sub>(4H) Janus intermediate. *J. Am. Chem. Soc.* **138**, 1320-1327.
128. Lukoyanov, D., Khadka, N., Yang, Z.-Y., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2016) Reductive elimination of H<sub>2</sub> activates nitrogenase to reduce the NN triple bond: characterization of the E<sub>4</sub>(4H) Janus intermediate in wild-type enzyme. *J. Am. Chem. Soc.* **138**, 10674-10683.
127. Khadka, N., Dean, D. R., Smith, D., Hoffman, B. M., Rauegi, S., and Seefeldt, L. C. (2016) CO<sub>2</sub> reduction catalyzed by nitrogenase: pathways to formate, carbon monoxide, and methane. *Inorg. Chem.* **55**, 8321-8330.
126. Fixen, K. R., Zheng, Y., Harris, D. F., Shaw, S., Yang, Z.-Y., Dean, D. R., Seefeldt, L. C., and Harwood, C. S. (2016) Light-driven carbon dioxide reduction to methane by nitrogenase in a photosynthetic bacterium. *Proc. Natl. Acad. Sci. U.S.A.* **113**, 10163-10167.
125. Davydov, R., Khadka, N., Yang, Z.-Y., Fielding, A. J., Lukoyanov, D., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2016) Exploring electron/proton transfer and conformational changes in the nitrogenase MoFe protein and FeMo-cofactor through cryoreduction/EPR measurements. *Isr. J. Chem.* **56**, 841-851.
124. Danyal, K., Shaw, S., Page, T. R., Duval, S., Horitani, M., Marts, A. R., Lukoyanov, D., Dean, D. R., Rauegi, S., Hoffman, B. M., Seefeldt, L. C., and Antony, E. (2016) Negative cooperativity in the nitrogenase Fe protein electron delivery cycle. *Proc. Natl. Acad. Sci. U.S.A.* **113**, E5783-E5791.
123. Brown, K. A., Harris, D. F., Wilker, M. B., Rasmussen, A., Khadka, N., Hamby, H., Keable, S., Dukovic, G., Peters, J. W., Seefeldt, L. C., and King, P. W. (2016) Light-driven dinitrogen reduction catalyzed by a CdS:nitrogenase MoFe protein biohybrid. *Science* **352**, 448-450.
122. Summers, H. M., Ledbetter, R. N., McCurdy, A. T., Morgan, M. R., Seefeldt, L. C., Jena, U., Kent Hoekman, S., and Quinn, J. C. (2015) Techno-economic feasibility and life cycle assessment of dairy

effluent to renewable diesel via hydrothermal liquefaction. *Bioresource Technology* 196, 431-440.

121. Jena, U., McCurdy, A. T., Warren, A., Summers, H., Ledbetter, R. N., Hoekman, S. K., Seefeldt, L. C., and Quinn, J. C. (2015) Oleaginous yeast platform for producing biofuels via co-solvent hydrothermal liquefaction. *Biotech. Biofuels* 8.
120. Danyal, K., Rasmussen, A. J., Keable, S. M., Inglet, B. S., Shaw, S., Zadvornyy, O. A., Duval, S., Dean, D. R., Raugei, S., Peters, J. W., and Seefeldt, L. C. (2015) Fe protein-independent substrate reduction by nitrogenase MoFe protein variants. *Biochemistry* 54, 2456-2462. doi: 10.1021/acs.biochem.5b00140
119. Lukoyanov, D., Yang, Z.-Y., Khadka, N., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2015) Identification of a key catalytic intermediate demonstrates that nitrogenase is activated by the reversible exchange of N<sub>2</sub> for H<sub>2</sub>. *J. Am. Chem. Soc.* 137, 3610-3615. doi: 10.1021/jacs.5b00103
118. McCurdy, A. T., Higham, A. J., Morgan, M. R., Quinn, J. C., and Seefeldt, L. C. (2015) Two-step process for production of biodiesel blends from oleaginous yeast and microalgae. *Fuel* 137, 269-276. doi: 10.1016/j.fuel.2014.07.099
117. Willis, R. M., McCurdy, A. T., Ogborn, M. K., Wahlen, B. D., Quinn, J. C., Pease III, L. F., and Seefeldt, L. C. (2014) Improving energetics of triacylglyceride extraction from wet oleaginous microbes. *Bioresource Technology* 167, 416-424. doi: 10.1016/j.biortech.2014.06.013
116. Shaw, S., Lukoyanov, D., Danyal, K., Dean, D. R., Hoffman, B. M., and Seefeldt, L. C. (2014) Nitrite and hydroxylamine as nitrogenase substrates: mechanistic implications for the pathway of N<sub>2</sub> reduction. *J. Am. Chem. Soc.* 136, 12776-12783. doi: 10.1021/ja507123d
115. Willis, R. M., McCurdy, A. T., Ogborn, M. K., Wahlen, B. D., Quinn, J. C., Pease III, L. F., and Seefeldt, L. C. (2014) Improving energetics of triacylglyceride extraction from wet oleaginous microbes. *Bioresource Technology* 167, 416-424. doi: 10.1016/j.biortech.2014.06.013
114. Smith, D., Danyal, K., Raugei, S., and Seefeldt, L. C. (2014) Substrate channel in nitrogenase revealed by a molecular dynamics approach. *Biochemistry* 53, 2278-2285. doi: 10.1021/bi401313j
113. Lukoyanov, D., Yang, Z.-Y., Duval, S., Danyal, K., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2014) A confirmation of the quench-cryoannealing relaxation protocol for identifying reduction states of freeze-trapped nitrogenase intermediates. *Inorg. Chem.* 53, 3688-3693. doi: 10.1021/ic500013c
112. Hoffman, B. M., Lukoyanov, D., Yang, Z.-Y., Dean, D. R., and Seefeldt, L. C. (2014) Mechanism of nitrogen fixation by nitrogenase: the next stage. *Chem. Rev.* 114, 4041-4062. doi: 10.1021/cr400641x
111. Yang, Z.-Y., Khadka, N., Lukoyanov, D., Hoffman, B. M., Dean, D. R., and Seefeldt, L. C. (2013) On reversible H<sub>2</sub> loss upon N<sub>2</sub> binding to FeMo-cofactor of nitrogenase. *Proc. Natl. Acad. Sci. U.S.A* 110, 16327-16332. Doi: 10.1073/pnas.1315852110
110. Wahlen, B. D., Morgan, M. R., McCurdy, A. T., Willis, R. M., Morgan, M. D., Dye, D. J., Bugbee, B., Wood, B. D., and Seefeldt, L. C. (2013) Biodiesel from microalgae, yeast, and bacteria: engine performance and exhaust emissions. *Energy Fuels* 27, 220-228.
109. Seefeldt, L. C., Yang, Z.-Y., Duval, S., and Dean, D. R. (2013) Nitrogenase reduction of carbon-containing compounds. *Biochim. Biophys. Acta* 1827, 1102-1111.
108. Moure, V. R., Danyal, K., Yang, Z.-Y., Wendroth, S., Miller-Santos, M., Pedrosa, F. O., Scarduelli, M., Gerhardt, E. C. M., Huergo, L. F., Souza, E. M., and Seefeldt, L. C. (2013) The nitrogenase regulatory enzyme dinitrogenase reductase ADP-ribosyltransferase (DraT) is activated by direct interaction with the signal transduction protein GlnB. *J. Bacteriol.* 195, 279-286.
107. Hoffman, B. M., Lukoyanov, D., Dean, D. R., and Seefeldt, L. C. (2013) Nitrogenase: a draft mechanism. *Acc. Chem. Res.* 46, 587-595.

106. Duval, S., Danyal, K., Shaw, S., Lytle, A. K., Dean, D. R., Hoffman, B. M., Antony, E., and Seefeldt, L. C. (2013) Electron transfer precedes ATP hydrolysis during nitrogenase catalysis. *Proc. Natl. Acad. Sci. U.S.A.* 110, 16414-16419.
105. Appel, A. M., Bercaw, J. E., Bocarsly, A. B., Dobbek, H., DuBois, D. L., Dupuis, M., Ferry, J. G., Fujita, E., Hille, R., Kenis, P. J. A., Kerfeld, C. A., Morris, R. H., Peden, C. H. F., Portis, A. R., Ragsdale, S. W., Rauchfuss, T. B., Reek, J. N. H., Seefeldt, L. C., Thauer, R. K., and Waldrop, G. L. (2013) Frontiers, opportunities, and challenges in biochemical and chemical catalysis of CO<sub>2</sub> fixation. *Chem. Rev.* 113, 6621-6658.
104. Adams, C., Godfrey, V., Wahlen, B., Seefeldt, L., and Bugbee, B. (2013) Understanding precision nitrogen stress to optimize the growth and lipid content tradeoff in oleaginous green microalgae. *Bioresour. Technol.* 131, 188-194.
103. Yang, Z.-Y., Moure, V. R., Dean, D. R., and Seefeldt, L. C. (2012) Carbon dioxide reduction to methane and coupling with acetylene to form propylene catalyzed by remodeled nitrogenase. *Proc. Natl. Acad. Sci. U.S.A.* 109, 19644-19648.
102. Seefeldt, L. C., Hoffman, B. M., and Dean, D. R. (2012) Electron transfer in nitrogenase catalysis. *Curr. Opin. Chem. Biol.* 16, 19-25.
101. Mayweather, D., Danyal, K., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2012) Temperature invariance of the nitrogenase electron transfer mechanism. *Biochemistry* 51, 8391-8398.
100. Lukoyanov, D., Yang, Z.-Y., Barney, B. M., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2012) Unification of reaction pathway and kinetic scheme for N<sub>2</sub> reduction catalyzed by nitrogenase. *Proc. Natl. Acad. Sci. U.S.A.* 109, 5583-5587.
99. George, S. J., Barney, B. M., Mitra, D., Igarashi, R. Y., Guo, Y., Dean, D. R., Cramer, S. P., and Seefeldt, L. C. (2012) EXAFS and NRVs reveal a conformational distortion of the FeMo-cofactor in the MoFe nitrogenase propargyl alcohol complex. *J. Inorg. Biochem.* 112, 85-92.
98. Barney, B. M., Wahlen, B. D., Garner, E., Wei, J., and Seefeldt, L. C. (2012) Differences in substrate specificities of five bacterial wax ester synthases. *Appl. Environ. Microbiol.* 78, 5734-5745.
97. Yang, Z.-Y., Seefeldt, L. C., Dean, D. R., Cramer, S. P., and George, S. J. (2011) Steric control of the Hi-CO MoFe nitrogenase complex revealed by stopped-flow infrared spectroscopy. *Angew. Chem. Int. Ed. Engl.* 50, 272-275.
96. Yang, Z.-Y., Dean, D. R., and Seefeldt, L. C. (2011) Molybdenum nitrogenase catalyzes the reduction and coupling of CO to form hydrocarbons. *J. Biol. Chem.* 286, 19417-19421.
95. Yang, Z.-Y., Danyal, K., and Seefeldt, L. C. (2011) Mechanism of Mo-dependent nitrogenase. *Methods Mol. Biol.* 766, 9-29.
94. Willis, R. M., Wahlen, B. D., Seefeldt, L. C., and Barney, B. M. (2011) Characterization of a fatty acyl-CoA reductase from *Marinobacter aquaeolei* VT8: a bacterial enzyme catalyzing the reduction of fatty acyl-CoA to fatty alcohol. *Biochemistry* 50, 10550-10558.
93. Wahlen, B. D., Willis, R. M., and Seefeldt, L. C. (2011) Biodiesel production by simultaneous extraction and conversion of total lipids from microalgae, cyanobacteria, and wild mixed-cultures. *Biores. Technol.* 102, 2724-2730.
92. Lukoyanov, D., Dikanov, S. A., Yang, Z.-Y., Barney, B. M., Samoilova, R. I., Narasimhulu, K. V., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2011) ENDOR/HYSCORE studies of the common intermediate trapped during nitrogenase reduction of N<sub>2</sub>H<sub>2</sub>, CH<sub>3</sub>N<sub>2</sub>H, and N<sub>2</sub>H<sub>4</sub> support an alternating reaction pathway for N<sub>2</sub> reduction. *J. Am. Chem. Soc.* 133, 11655-11664.

91. Doan, P. E., Telser, J., Barney, B. M., Igarashi, R. Y., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2011)  $^{57}\text{Fe}$  ENDOR spectroscopy and electron inventory analysis of the nitrogenase E4 intermediate suggest the metal-ion core of FeMo-cofactor cycles through only one redox couple. *J. Am. Chem. Soc.* 133, 17329-17340.
90. Danyal, K., Yang, Z.-Y., and Seefeldt, L. C. (2011) Electron paramagnetic resonance spectroscopy. *Methods Mol. Biol.* 766, 191-205.
89. Danyal, K., Dean, D. R., Hoffman, B. M., and Seefeldt, L. C. (2011) Electron transfer within nitrogenase: evidence for a deficit-spending mechanism. *Biochemistry* 50, 9255-9263.
88. Sarma, R., Barney, B. M., Keable, S., Dean, D. R., Seefeldt, L. C., and Peters, J. W. (2010) Insights into substrate binding at FeMo-cofactor in nitrogenase from the structure of an  $[\alpha]$ -70Ile MoFe protein variant. *J. Inorg. Biochem.* 104, 385-389.
87. Lukoyanov, D., Yang, Z.-Y., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2010) Is Mo involved in hydride binding by the four-electron reduced (E4) intermediate of the nitrogenase MoFe protein? *J. Am. Chem. Soc.* 132, 2526-2527.
86. Danyal, K., Mayweather, D., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2010) Conformational gating of electron transfer from the nitrogenase Fe protein to MoFe protein. *J. Am. Chem. Soc.* 132, 6894-6895.
85. Danyal, K., Inglet, B. S., Vincent, K. A., Barney, B. M., Hoffman, B. M., Armstrong, F. A., Dean, D. R., and Seefeldt, L. C. (2010) Uncoupling nitrogenase: catalytic reduction of hydrazine to ammonia by a MoFe protein in the absence of Fe protein-ATP. *J. Am. Chem. Soc.* 132, 13197-13199.
84. Wahlen, B. D., Oswald, W. S., Seefeldt, L. C., and Barney, B. M. (2009) Purification, characterization, and potential bacterial wax production role of an NADPH-dependent fatty aldehyde reductase from *Marinobacter aquaeolei* VT8. *Appl. Environ. Microbiol.* 75, 2758-2764.
83. Seefeldt, L. C., Hoffman, B. M., and Dean, D. R. (2009) Mechanism of Mo-dependent nitrogenase. *Annu. Rev. Biochem.* 78, 701-722.
82. Hoffman, B. M., Dean, D. R., and Seefeldt, L. C. (2009) Climbing nitrogenase: toward a mechanism of enzymatic nitrogen fixation. *Acc. Chem. Res.* 42, 609-619.
81. Harris, D., and Seefeldt, L. (2009) An updated kinetic study of the enzyme lactase for the biochemistry laboratory. *J. Chem. Ed.* 86, 1271.
80. Barney, B. M., Yurth, M. G., Dos Santos, P. C., Dean, D. R., and Seefeldt, L. C. (2009) A substrate channel in the nitrogenase MoFe protein. *J. Biol. Inorg. Chem.* 14, 1015-1022.
79. Barney, B. M., Lukoyanov, D., Igarashi, R. Y., Laryukhin, M., Yang, T.-C., Dean, D. R., Hoffman, B. M., and Seefeldt, L. C. (2009) Trapping an intermediate of dinitrogen ( $\text{N}_2$ ) reduction on nitrogenase. *Biochemistry* 48, 9094-9102.
78. Wahlen, B. D., Barney, B. M., and Seefeldt, L. C. (2008) Synthesis of biodiesel from mixed feedstocks and longer chain alcohols using an acid-catalyzed method. *Energy Fuels* 22, 4223-4228.
77. Sarma, R., Barney, B. M., Hamilton, T. L., Jones, A., Seefeldt, L. C., and Peters, J. W. (2008) Crystal structure of the L protein of *Rhodobacter sphaeroides* light-independent protochlorophyllide reductase with MgADP bound: a homologue of the nitrogenase Fe protein. *Biochemistry* 47, 13004-13015.
76. Sarma, R., Mulder, D. W., Brecht, E., Szilagyi, R. K., Seefeldt, L. C., Tsuruta, H., and Peters, J. W. (2007) Probing the MgATP-bound conformation of the nitrogenase Fe protein by solution small-angle X-ray scattering. *Biochemistry* 46, 14058-14066.

75. Lukoyanov, D., Pelmeshnikov, V., Maeser, N., Laryukhin, M., Yang, T. C., Noodleman, L., Dean, D. R., Case, D. A., Seefeldt, L. C., and Hoffman, B. M. (2007) Testing if the interstitial atom, X, of the nitrogenase molybdenum-iron cofactor is N or C: ENDOR, ESEEM, and DFT studies of the  $S = 3/2$  resting state in multiple environments. *Inorg. Chem.* 46, 11437-11449.
74. Lukoyanov, D., Barney, B. M., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2007) Connecting nitrogenase intermediates with the kinetic scheme for  $N_2$  reduction by a relaxation protocol and identification of the  $N_2$  binding state. *Proc. Natl. Acad. Sci. U.S.A.* 104, 1451-1455.
73. Dos Santos, P. C., Mayer, S. M., Barney, B. M., Seefeldt, L. C., and Dean, D. R. (2007) Alkyne substrate interaction within the nitrogenase MoFe protein. *J. Inorg. Biochem.* 101, 1642-1648.
72. Barney, B. M., McClead, J., Lukoyanov, D., Laryukhin, M., Yang, T.-C., Dean, D. R., Hoffman, B. M., and Seefeldt, L. C. (2007) Diazene ( $HN=NH$ ) is a substrate for nitrogenase: insights into the pathway of  $N_2$  reduction. *Biochemistry* 46, 6784-6794.
71. Sen, S., Krishnakumar, A., McClead, J., Johnson, M. K., Seefeldt, L. C., Szilagyi, R. K., and Peters, J. W. (2006) Insights into the role of nucleotide-dependent conformational change in nitrogenase catalysis: Structural characterization of the nitrogenase Fe protein Leu127 deletion variant with bound MgATP. *J. Inorg. Biochem.* 100, 1041-1052.
70. Barney, B. M., Lukoyanov, D., Yang, T.-C., Dean, D. R., Hoffman, B. M., and Seefeldt, L. C. (2006) A methyl diazene ( $HN=N-CH_3$ )-derived species bound to the nitrogenase active-site FeMo cofactor: Implications for mechanism. *Proc. Natl. Acad. Sci. U.S.A.* 103, 17113-17118.
69. Barney, B. M., Lee, H.-I., Dos Santos, P. C., Hoffman, B. M., Dean, D. R., and Seefeldt, L. C. (2006) Breaking the  $N_2$  triple bond: insights into the nitrogenase mechanism. *Dalton Trans* 2277-2284.
68. Yang, T.-C., Maeser, N. K., Laryukhin, M., Lee, H.-I., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2005) The interstitial atom of the nitrogenase FeMo-cofactor: ENDOR and ESEEM evidence that it is not a nitrogen. *J. Am. Chem. Soc.* 127, 12804-12805.
67. Igarashi, R. Y., Laryukhin, M., Dos Santos, P. C., Lee, H.-I., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2005) Trapping H- bound to the nitrogenase FeMo-cofactor active site during  $H_2$  evolution: characterization by ENDOR spectroscopy. *J. Am. Chem. Soc.* 127, 6231-6241.
66. Dos Santos, P. C., Igarashi, R. Y., Lee, H.-I., Hoffman, B. M., Seefeldt, L. C., and Dean, D. R. (2005) Substrate interactions with the nitrogenase active site. *Acc. Chem. Res.* 38, 208-214.
65. Barney, B. M., Yang, T.-C., Igarashi, R. Y., Dos Santos, P. C., Laryukhin, M., Lee, H.-I., Hoffman, B. M., Dean, D. R., and Seefeldt, L. C. (2005) Intermediates trapped during nitrogenase reduction of  $NN$ ,  $CH_3-N=NH$ , and  $H_2N-NH_2$ . *J. Am. Chem. Soc.* 127, 14960-14961.
64. Barney, B. M., Laryukhin, M., Igarashi, R. Y., Lee, H.-I., Dos Santos, P. C., Yang, T.-C., Hoffman, B. M., Dean, D. R., and Seefeldt, L. C. (2005) Trapping a hydrazine reduction intermediate on the nitrogenase active site. *Biochemistry* 44, 8030-8037.
63. Sen, S., Igarashi, R., Smith, A., Johnson, M. K., Seefeldt, L. C., and Peters, J. W. (2004) A conformational mimic of the MgATP-bound on state of the nitrogenase iron protein. *Biochemistry* 43, 1787-1797.
62. Seefeldt, L. C., Dance, I. G., and Dean, D. R. (2004) Substrate interactions with nitrogenase: Fe versus Mo. *Biochemistry* 43, 1401-1409.
61. Lee, H.-I., Igarashi, R. Y., Laryukhin, M., Doan, P. E., Dos Santos, P. C., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2004) An organometallic intermediate during alkyne reduction by nitrogenase. *J. Am. Chem. Soc.* 126, 9563-9569.

60. Jang, S. B., Jeong, M. S., Seefeldt, L. C., and Peters, J. W. (2004) Structural and biochemical implications of single amino acid substitutions in the nucleotide-dependent switch regions of the nitrogenase Fe protein from *Azotobacter vinelandii*. *J. Biol. Inorg. Chem* 9, 1028-1033.
59. Igarashi, R. Y., Dos Santos, P. C., Niehaus, W. G., Dance, I. G., Dean, D. R., and Seefeldt, L. C. (2004) Localization of a catalytic intermediate bound to the FeMo-cofactor of nitrogenase. *J. Biol. Chem* 279, 34770-34775.
58. Barney, B. M., Igarashi, R. Y., Dos Santos, P. C., Dean, D. R., and Seefeldt, L. C. (2004) Substrate interaction at an iron-sulfur face of the FeMo-cofactor during nitrogenase catalysis. *J. Biol. Chem.* 279, 53621-53624.
57. Srlie, M., Chan, J. M., Wang, H., Seefeldt, L. C., and Parker, V. D. (2003) Elucidating thermodynamic parameters for electron transfer proteins using isothermal titration calorimetry: application to the nitrogenase Fe protein. *J. Biol. Inorg. Chem* 8, 560-566.
56. Lee, H.-I., Benton, P. M. C., Laryukhin, M., Igarashi, R. Y., Dean, D. R., Seefeldt, L. C., and Hoffman, B. M. (2003) The interstitial atom of the nitrogenase FeMo-cofactor: ENDOR and ESEEM show it is not an exchangeable nitrogen. *J. Am. Chem. Soc.* 125, 5604-5605.
55. Igarashi, R. Y., and Seefeldt, L. C. (2003) Nitrogen fixation: the mechanism of the Mo-dependent nitrogenase. *Crit. Rev. Biochem. Mol. Biol* 38, 351-384.
54. Benton, P. M. C., Laryukhin, M., Mayer, S. M., Hoffman, B. M., Dean, D. R., and Seefeldt, L. C. (2003) Localization of a substrate binding site on the FeMo-cofactor in nitrogenase: trapping propargyl alcohol with an alpha-70-substituted MoFe protein. *Biochemistry* 42, 9102-9109.
53. Christiansen, J., Dean, D. R., and Seefeldt, L. C. (2001) Mechanistic features of the Mo-containing nitrogenase. *Annu. Rev. Plant Physiol. Plant Mol. Biol* 52, 269-295.
52. Chiu, H., Peters, J. W., Lanzilotta, W. N., Ryle, M. J., Seefeldt, L. C., Howard, J. B., and Rees, D. C. (2001) MgATP-Bound and nucleotide-free structures of a nitrogenase protein complex between the Leu 127 Delta-Fe-protein and the MoFe-protein. *Biochemistry* 40, 641-650.
51. Benton, P. M. C., Mayer, S. M., Shao, J., Hoffman, B. M., Dean, D. R., and Seefeldt, L. C. (2001) Interaction of Acetylene and Cyanide with the Resting State of Nitrogenase -96-Substituted MoFe Proteins. *Biochemistry* 40, 13816-13825.
50. Benton, P. M., Christiansen, J., Dean, D. R., and Seefeldt, L. C. (2001) Stereospecificity of acetylene reduction catalyzed by nitrogenase. *J. Am. Chem. Soc* 123, 1822-1827.
49. Srlie, M., Seefeldt, L. C., and Parker, V. D. (2000) Use of stopped-flow spectrophotometry to establish midpoint potentials for redox proteins. *Anal. Biochem* 287, 118-125.
48. Ryle, M. J., and Seefeldt, L. C. (2000) Hydrolysis of nucleoside triphosphates other than ATP by nitrogenase. *J. Biol. Chem* 275, 6214-6219.
47. Ryle, M. J., Lee, H. I., Seefeldt, L. C., and Hoffman, B. M. (2000) Nitrogenase reduction of carbon disulfide: freeze-quench EPR and ENDOR evidence for three sequential intermediates with cluster-bound carbon moieties. *Biochemistry* 39, 1114-1119.
46. Jang, S. B., Seefeldt, L. C., and Peters, J. W. (2000) Modulating the midpoint potential of the [4Fe-4S] cluster of the nitrogenase Fe protein. *Biochemistry* 39, 641-648.
45. Jang, S. B., Seefeldt, L. C., and Peters, J. W. (2000) Insights into nucleotide signal transduction in nitrogenase: structure of an iron protein with MgADP bound. *Biochemistry* 39, 14745-14752.



44. Christiansen, J., Seefeldt, L. C., and Dean, D. R. (2000) Competitive substrate and inhibitor interactions at the physiologically relevant active site of nitrogenase. *J. Biol. Chem.* 275, 36104-36107.
43. Christiansen, J., Chan, J. M., Seefeldt, L. C., and Dean, D. R. (2000) The role of the MoFe protein alpha-125Phe and beta-125Phe residues in *Azotobacter vinelandii* MoFe protein-Fe protein interaction. *J. Inorg. Biochem* 80, 195-204.
42. Christiansen, J., Cash, V. L., Seefeldt, L. C., and Dean, D. R. (2000) Isolation and characterization of an acetylene-resistant nitrogenase. *J. Biol. Chem.* 275, 11459-11464.
41. Chan, J. M., Wu, W., Dean, D. R., and Seefeldt, L. C. (2000) Construction and characterization of a heterodimeric iron protein: defining roles for adenosine triphosphate in nitrogenase catalysis. *Biochemistry* 39, 7221-7228.
40. Lanzilotta, W. N., Parker, V. D., and Seefeldt, L. C. (1999) Thermodynamics of nucleotide interactions with the *Azotobacter vinelandii* nitrogenase iron protein. *Biochim. Biophys. Acta* 1429, 411-421.
39. Chan, J. M., Ryle, M. J., and Seefeldt, L. C. (1999) Evidence that MgATP accelerates primary electron transfer in a *Clostridium pasteurianum* Fe protein-*Azotobacter vinelandii* MoFe protein nitrogenase tight complex. *J. Biol. Chem* 274, 17593-17598.
38. Chan, J. M., Christiansen, J., Dean, D. R., and Seefeldt, L. C. (1999) Spectroscopic evidence for changes in the redox state of the nitrogenase P-cluster during turnover. *Biochemistry* 38, 5779-5785.
37. Peters, J. W., Lanzilotta, W. N., Lemon, B. J., and Seefeldt, L. C. (1998) X-ray crystal structure of the Fe-only hydrogenase (CpI) from *Clostridium pasteurianum* to 1.8 angstrom resolution. *Science* 282, 1853-1858.
36. Lanzilotta, W. N., Parker, V. D., and Seefeldt, L. C. (1998) Electron transfer in nitrogenase analyzed by Marcus theory: evidence for gating by MgATP. *Biochemistry* 37, 399-407.
35. Lanzilotta, W. N., Christiansen, J., Dean, D. R., and Seefeldt, L. C. (1998) Evidence for coupled electron and proton transfer in the [8Fe-7S] cluster of nitrogenase. *Biochemistry* 37, 11376-11384.
34. Christiansen, J., Goodwin, P. J., Lanzilotta, W. N., Seefeldt, L. C., and Dean, D. R. (1998) Catalytic and biophysical properties of a nitrogenase Apo-MoFe protein produced by a *nifB*-deletion mutant of *Azotobacter vinelandii*. *Biochemistry* 37, 12611-12623.
33. Seefeldt, L. C., and Dean, D. R. (1997) Role of nucleotides in nitrogenase catalysis. *Acc. Chem. Res* 30, 260-266.
32. Rasche, M. E., and Seefeldt, L. C. (1997) Reduction of thiocyanate, cyanate, and carbon disulfide by nitrogenase: kinetic characterization and EPR spectroscopic analysis. *Biochemistry* 36, 8574-8585.
31. Parker, V. D., and Seefeldt, L. C. (1997) A mediated thin-layer voltammetry method for the study of redox protein electrochemistry. *Anal. Biochem* 247, 152-157.
30. Parker, V. D., Roddick, A., Seefeldt, L. C., Wang, H., and Zheng, G. (1997) Determination of rate and equilibrium constants for the reactions between electron transfer mediators and proteins by linear sweep voltammetry. *Anal. Biochem* 249, 212-218.
29. Liu, Y., Seefeldt, L. C., and Parker, V. D. (1997) Entropies of redox reactions between proteins and mediators: the temperature dependence of reversible electrode potentials in aqueous buffers. *Anal. Biochem* 250, 196-202.
28. Lanzilotta, W. N., and Seefeldt, L. C. (1997) Changes in the midpoint potentials of the nitrogenase metal centers as a result of iron protein-molybdenum-iron protein complex formation. *Biochemistry* 36, 12976-12983.

27. Lanzilotta, W. N., Fisher, K., and Seefeldt, L. C. (1997) Evidence for electron transfer-dependent formation of a nitrogenase iron protein-molybdenum-iron protein tight complex. The role of aspartate 39. *J. Biol. Chem* 272, 4157-4165.
26. Ryle, M. J., and Seefeldt, L. C. (1996) The [4Fe-4S] cluster domain of the nitrogenase iron protein facilitates conformational changes required for the cooperative binding of two nucleotides. *Biochemistry* 35, 15654-15662.
25. Ryle, M. J., and Seefeldt, L. C. (1996) Elucidation of a MgATP signal transduction pathway in the nitrogenase iron protein: formation of a conformation resembling the MgATP-bound state by protein engineering. *Biochemistry* 35, 4766-4775.
24. Ryle, M. J., Lanzilotta, W. N., and Seefeldt, L. C. (1996) Elucidating the mechanism of nucleotide-dependent changes in the redox potential of the [4Fe-4S] cluster in nitrogenase iron protein: the role of phenylalanine 135. *Biochemistry* 35, 9424-9434.
23. Ryle, M. J., Lanzilotta, W. N., Seefeldt, L. C., Scarrow, R. C., and Jensen, G. M. (1996) Circular dichroism and x-ray spectroscopies of *Azotobacter vinelandii* nitrogenase iron protein. MgATP and MgADP induced protein conformational changes affecting the [4Fe-4S] cluster and characterization of a [2Fe-2S] form. *J. Biol. Chem* 271, 1551-1557.
22. Lanzilotta, W. N., and Seefeldt, L. C. (1996) Electron transfer from the nitrogenase iron protein to the [8Fe-(7/8)S] clusters of the molybdenum-iron protein. *Biochemistry* 35, 16770-16776.
21. Lanzilotta, W. N., Fisher, K., and Seefeldt, L. C. (1996) Evidence for electron transfer from the nitrogenase iron protein to the molybdenum-iron protein without MgATP hydrolysis: characterization of a tight protein-protein complex. *Biochemistry* 35, 7188-7196.
20. Seefeldt, L. C., Rasche, M. E., and Ensign, S. A. (1995) Carbonyl sulfide and carbon dioxide as new substrates, and carbon disulfide as a new inhibitor, of nitrogenase. *Biochemistry* 34, 5382-5389.
19. Ryle, M. J., Lanzilotta, W. N., Mortenson, L. E., Watt, G. D., and Seefeldt, L. C. (1995) Evidence for a central role of lysine 15 of *Azotobacter vinelandii* nitrogenase iron protein in nucleotide binding and protein conformational changes. *J. Biol. Chem* 270, 13112-13117.
18. Lanzilotta, W. N., Ryle, M. J., and Seefeldt, L. C. (1995) Nucleotide hydrolysis and protein conformational changes in *Azotobacter vinelandii* nitrogenase iron protein: defining the function of aspartate 129. *Biochemistry* 34, 10713-10723.
17. Lanzilotta, W. N., Holz, R. C., and Seefeldt, L. C. (1995) Proton NMR investigation of the [4Fe-4S]<sup>1+</sup> cluster environment of nitrogenase iron protein from *Azotobacter vinelandii*: defining nucleotide-induced conformational changes. *Biochemistry* 34, 15646-15653.
16. Chen, J. C., Mortenson, L. E., and Seefeldt, L. C. (1995) Analysis of a gene region required for dihydrogen oxidation in *Azotobacter vinelandii*. *Curr. Microbiol* 30, 351-355.
15. Seefeldt, L. C. (1994) Docking of nitrogenase iron- and molybdenum-iron proteins for electron transfer and MgATP hydrolysis: the role of arginine 140 and lysine 143 of the *Azotobacter vinelandii* iron protein. *Protein Sci* 3, 2073-2081.
14. Seefeldt, L. C., and Ensign, S. A. (1994) A continuous, spectrophotometric activity assay for nitrogenase using the reductant titanium(III) citrate. *Anal. Biochem* 221, 379-386.
13. Seefeldt, L. C., and Mortenson, L. E. (1993) Increasing nitrogenase catalytic efficiency for MgATP by changing serine 16 of its Fe protein to threonine: use of Mn<sup>2+</sup> to show interaction of serine 16 with Mg<sup>2+</sup>. *Protein Sci* 2, 93-102.

12. Mortenson, L. E., Seefeldt, L. C., Morgan, T. V., and Bolin, J. T. (1993) The role of metal clusters and MgATP in nitrogenase catalysis. *Adv. Enzymol. Relat. Areas Mol. Biol* 67, 299-374.
11. Seefeldt, L. C., Morgan, T. V., Dean, D. R., and Mortenson, L. E. (1992) Mapping the site(s) of MgATP and MgADP interaction with the nitrogenase of *Azotobacter vinelandii*. Lysine 15 of the iron protein plays a major role in MgATP interaction. *J. Biol. Chem* 267, 6680-6688.
10. Hyman, M. R., Seefeldt, L. C., Morgan, T. V., Arp, D. J., and Mortenson, L. E. (1992) Kinetic and spectroscopic analysis of the inactivating effects of nitric oxide on the individual components of *Azotobacter vinelandii* nitrogenase. *Biochemistry* 31, 2947-2955.
9. Ford, C. M., Garg, N., Garg, R. P., Tibelius, K. H., Yates, M. G., Arp, D. J., and Seefeldt, L. C. (1990) The identification, characterization, sequencing and mutagenesis of the genes (*hupSL*) encoding the small and large subunits of the H<sub>2</sub>-uptake hydrogenase of *Azotobacter chroococcum*. *Mol. Microbiol* 4, 999-1008.
8. Seefeldt, L. C., and Arp, D. J. (1989) Oxygen effects on the nickel- and iron-containing hydrogenase from *Azotobacter vinelandii*. *Biochemistry* 28, 1588-1596.
7. Seefeldt, L. C., and Arp, D. J. (1989) Cyanide inactivation of hydrogenase from *Azotobacter vinelandii*. *J. Bacteriol* 171, 3298-3303.
6. Kovacs, K. L., Seefeldt, L. C., Tigyi, G., Doyle, C. M., Mortenson, L. E., and Arp, D. J. (1989) Immunological relationship among hydrogenases. *J. Bacteriol* 171, 430-435.
5. Hyman, M. R., Seefeldt, L. C., and Arp, D. J. (1988) Aerobic, inactive forms of *Azotobacter vinelandii* hydrogenase: activation kinetics and insensitivity to C<sub>2</sub>H<sub>2</sub> inhibition. *Biochim. Biophys. Acta* 957, 91-96.
4. Seefeldt, L. C., and Arp, D. J. (1987) Redox-dependent subunit dissociation of *Azotobacter vinelandii* hydrogenase in the presence of sodium dodecyl sulfate. *J. Biol. Chem* 262, 16816-16821.
3. Seefeldt, L. C., Fox, C. A., and Arp, D. J. (1986) Reversible inactivation of the O<sub>2</sub>-labile hydrogenases from *Azotobacter vinelandii* and *Rhizobium japonicum*. *J. Biol. Chem* 261, 10688-10694.
2. Seefeldt, L. C., and Arp, D. J. (1986) Purification to homogeneity of *Azotobacter vinelandii* hydrogenase: a nickel and iron containing alpha beta dimer. *Biochimie* 68, 25-34.
1. Arp, D. J., McCollum, L. C., and Seefeldt, L. C. (1985) Molecular and immunological comparison of membrane-bound, H<sub>2</sub>-oxidizing hydrogenases of *Bradyrhizobium japonicum*, *Alcaligenes eutrophus*, *Alcaligenes latus*, and *Azotobacter vinelandii*. *J. Bacteriol* 163, 15-20.

## PUBLICATIONS – CHAPTERS

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27. Patil, B. S., Hessel, V., Seefeldt, L. C., Dean, D. R., Hoffman, B. M., Cook, B. J., and Murray, L. J. (2017) Nitrogen Fixation, in *Ullmanns Encyclopedia of Industrial Chemistry*, pp 121. Wiley-VCH Verlag GmbH & Co. KGaA.
26. Yang, Z.Y., Danyal, K., Seefeldt, L.C. (2011), Mechanism of Mo-dependent nitrogenase. *Methods Mol. Biol.* 766, 9-29.
25. Danyal, K., Yang, Z.Y., Seefeldt, L.C. (2011) Electron paramagnetic resonance spectroscopy. *Methods Mol. Biol.* 766, 191-205.
24. Mayer, S.M., Dos Santos, P.C., Seefeldt, L.C., and Dean, D.R. 2004. Strategies for the functional analysis of the *Azotobacter vinelandii* MoFe protein and its active site FeMo-cofactor. In *Catalysts for Nitrogen Fixation: Nitrogenases, Relevant Chemical Models, and Commercial Processes* (eds. Smith, B.E., Richards, R.L., and Newton, W.E.), 141-159.

23. Igarashi, R.Y., and Seefeldt, L.C. 2004. The mechanism of Mo-dependent nitrogenase: thermodynamics and kinetics. In *Catalysts for Nitrogen Fixation: Nitrogenases, Relevant Chemical Models, and Commercial Processes* (eds. Smith, B.E., Richards, R.L., and Newton, W.E.), 97-140.
22. Mayer, S.M., Christiansen, J., Dos Santos, P.C., Niehaus, W.G., Benton, P., Seefeldt, L.C., and Dean, D.R. 2002. Localization of the nitrogenase substrate binding site. In *Nitrogen Fixation: Global Perspectives, Proceedings of the International Congress on Nitrogen Fixation*, 15-19.
21. Christiansen, J., Dean, D.R., and Seefeldt, L.C. 2001. Mechanistic features of the Mo-containing nitrogenase. In *Annual Reviews of Plant Physiology and Plant Molecular Biology* 52, 269-295.
20. Christiansen, J., Chan, J.M., Seefeldt, L.C., and Dean, D.R. 2000. Use of amino acid substitutions to study the functional properties of the nitrogenase MoFe protein. In *Prokaryotic Nitrogen Fixation: A Model System for Analysis of a Biological Process*. E. Triplett, ed, Horizon Scientific Press, Wymondham, UK.
19. Chan, J.M., Huyett, J.E., and Seefeldt, L.C. 2000. Roles for nucleotides in nitrogenase catalysis. In *Prokaryotic Nitrogen Fixation: A Model System for Analysis of a Biological Process*. E. Triplett, ed, Horizon Scientific Press, Wymondham, UK.
18. Seefeldt, L.C. 2000. Roles for nucleotides in nitrogenase catalysis. In *Nitrogen Fixation: From Molecules to Crop Productivity*. F.O. Pedrosa, M. Hungria, M.G. Yates, and W.E. Newton, eds, Kluwer Academic Publishers, Boston, p. 19.
17. Lanzilotta, W.N., and Seefeldt, L.C. 1998. Electron transfer reactions in nitrogenase and the role of MgATP. In *Biological Nitrogen Fixation for the 21st Century*. C. Elmerich, A. Kondorosi, and W.E. Newton, eds, Kluwer Academic Publishers, Boston, p. 72.
16. Chan, J.M., Ryle, M.J., and Seefeldt, L.C. 1998. Electron transfer reactions within the heterologous *Clostridium pasteurianum* Fe protein-Azotobacter vinelandii MoFe protein nitrogenase complex. In *Biological Nitrogen Fixation for the 21st Century*. C. Elmerich, A. Kondorosi, and W.E. Newton, eds, Kluwer Academic Publishers, Boston, p. 71.
15. Seefeldt, L.C., Ryle, M.J., Chan, J.M., and Lanzilotta, W.N. 1998. Nucleotide hydrolysis and electron transfer reactions in nitrogenase catalysis. In *Biological Nitrogen Fixation for the 21st Century*. C. Elmerich, A. Kondorosi, and W.E. Newton, eds, Kluwer Academic Publishers, Boston, p. 39.
14. Rees, D.C., Schindelin, H., Kisker, C., Schlessman, J., Peters, J.W., Seefeldt, L.C., and Howard, J.B. 1998. Complex structures of nitrogenase. In *Biological Nitrogen Fixation for the 21st Century*. C. Elmerich, A. Kondorosi, and W.E. Newton, eds, Kluwer Academic Publishers, Boston, p. 11.
13. Seefeldt, L.C., Rasche, M.E., and Ensign, S.A. 1995. Carbonyl sulfide and carbon dioxide as new substrates and carbon disulfide as a new inhibitor of nitrogenase. In *Nitrogen Fixation: Fundamentals and Applications*. I.A. Tikhonovich, N.A. Provorov, V.I. Romanov, and W.N. Newton, Eds., Kluwer Academic Publishers, Boston. p. 162.
12. Ryle, M.J., and Seefeldt, L.C. 1995. Altering the [4Fe-4S] cluster environment of Azotobacter vinelandii nitrogenase iron protein: The role of phenylalanine 135. In *Nitrogen Fixation: Fundamentals and Applications*. I.A. Tikhonovich, N.A. Provorov, V.I. Romanov, and W.N. Newton, Eds., Kluwer Academic Publishers, Boston. p. 161.
11. Lanzilotta, W.N., and Seefeldt, L.C. 1995. Nucleotide hydrolysis and protein conformational changes in Azotobacter vinelandii nitrogenase iron protein: Defining the function of aspartate 129. In *Nitrogen Fixation: Fundamentals and Applications*. I.A. Tikhonovich, N.A. Provorov, V.I. Romanov, and W.N. Newton, Eds., Kluwer Academic Publishers, Boston. p. 157.

10. Seefeldt, L.C., Morgan, T.V., and Mortenson, L.E. 1993. Essential residues for nitrogenase interaction with MgATP defined: Site-directed mutagenesis of the Fe protein. In *New Horizons in Nitrogen Fixation*. R. Palacios, J. Mora and W.E. Newton, Eds., Kluwer Academic Publishers, Boston. p. 151.
9. Morgan, T.V., Seefeldt, L.C., and Mortenson, L.E. 1993. Mapping the sites of MgATP interactions with the nitrogenase Fe protein. In *New Horizons in Nitrogen Fixation*. R. Palacios, J. Mora and W.E. Newton, Eds., Kluwer Academic Publishers, Boston. p. 145.
8. Mortenson, L.E., Morgan, T.V., and Seefeldt, L.C. 1993. Use of Fe protein altered at specific amino acid positions to probe its function in nitrogenase catalysis. In *New Horizons in Nitrogen Fixation*. R. Palacios, J. Mora and W.E. Newton, Eds., Kluwer Academic Publishers, Boston. pp. 111-116.
7. Mortenson, L.E., Seefeldt, L.C., Morgan, T.V., and Bolin, J.T. 1993. The role of metal clusters and MgATP in nitrogenase catalysis. *Adv. Enzymology* 67, 299-374.
6. Seefeldt, L.C. and Mortenson, L.E. 1993. The mechanism of MgATP utilization by nitrogenase. *J. Inorganic Biochem.* 51, 362.
5. Mortenson, L.E., Seefeldt, L.C., and Morgan, T.V. 1993. The functional specificity of the amino acids of the Fe protein of nitrogenase. *J. Inorganic Biochem.* 51, 347.
4. Seefeldt, L.C., Robson, R. and Mortenson, L.E. 1990. Site-directed mutagenesis of the proposed MgATP binding region of nitrogenase iron protein from *Azotobacter chroococcum*. In *Nitrogen Fixation: Achievements and Objectives*. P.M. Gresshoff, L.E. Roth, G. Stacey and W.E. Newton, Eds. Chapman and Hall, New York. p. 170.
3. Yates, M.G., Ford, C.M., Tibelius, K.H., Campbell, F., Arp, D.J., and Seefeldt, L.C. 1988. Aspects of the physiology and genetics of the H<sub>2</sub>-uptake hydrogenase of *Azotobacter chroococcum*. In *Nitrogen Fixation: Hundred Years After*. H. Bothe, F.J. de Bruijn and W.E. Newton, Eds. Gustav Fischer, New York. pp. 263-269.
2. Seefeldt, L.C. and Arp, D.J. 1985. Purification to homogeneity of *Azotobacter vinelandii* hydrogenase: a nickel and iron containing dimer. In *Nitrogen Fixation Research Progress*. H.J. Evans, P.J. Bottomley and W.E. Newton, Eds. Martinus Nijhoff Publishers, Boston. p. 445.
1. Arp, D.J, McCollum, L., Doyle, C., and Seefeldt, L.C. 1985. Immunological comparison of H<sub>2</sub>-oxidizing hydrogenases. In *Nitrogen Fixation Research Progress*. H.J. Evans, P.J. Bottomley and W.E. Newton, Eds. Martinus Nijhoff Publishers, Boston. p. 356.

## INVITED PRESENTATIONS

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- 2017 Photosynthesis Systems, Department of Energy meeting, Washington, DC.
- 2017 Mo and W Enzymes Meeting, Santa Fe New Mexico.
- 2017 University of Amsterdam, Amsterdam, Netherlands.
- 2017 Bioelectrochemical Society Meeting, Lyon, France.
- 2017 Energy Frontiers Research Centers Meeting, Washington, DC.
- 2017 Proton Coupled Electron Transfer, Telluride Summer Research Meetings, Telluride, CO.
- 2017 International Congress on Nitrogen Fixation, Grenada, Spain.
- 2017 Gordon Research Conference, Inorganic Reaction Mechanism.
- 2017 Gordon Research Conference, Metals in Biology.
- 2016 Gordon Research Conference, Metalloclusters.

- 2015 Mo/W Enzymes Congress, Balatonfured, Hungary.
- 2015 FeS Cluster Biogenesis Meeting, Bergamo, Italy.
- 2015 National Renewable Energy Laboratory, Golden, Colorado.
- 2015 Energy Frontiers Research Center Meeting, Washington DC.
- 2015 19th International Congress on Nitrogen Fixation, Asilomar, California.
- 2014 European Congress on Nitrogen Fixation, Canary Islands, Spain.
- 2014 NASA Workshop, CO2 Based Manufacturing, Moffett Field, CA.
- 2014 Gordon Research Conference, Fe-S clusters.
- 2014 University of Minnesota, Department of Chemistry.
- 2014 Gordon Research Conference, Metals in Biology, Ventura, CA.
- 2013 18th International Congress on Nitrogen Fixation, Miyazaki Japan (plenary lecture).
- 2013 Mini-symposium on nitrogen fixation, Nagoya, Japan.
- 2013 Mo/W Enzymes Congress, Sintra, Portugal.
- 2013 International Congress on Bioinorganic Chemistry, Grenoble France (plenary lecture).
- 2012 Gordon Research Conference, C1 Metabolism.
- 2012 National Science Foundation Workshop, Origins of Life, Arlington, VA.
- 2012 Frontiers in Biological Sciences and Integrated Catalysis Sciences, Pacific Northwest National Laboratory, Richland WA.
- 2012 Gordon Research Conference, FeS Proteins, Mount Holyoke College, South Hadley, MA (session chair).
- 2012 Department of Chemistry, Northwestern University, Evanston, IL.
- 2012 American Chemical Society National Meeting, San Diego, California (speaker).
- 2012 Workshop on Metal Hydrides in Biology, Oxford England (co-organizer and speaker).
- 2012 Gordon Research Conference, Metals in Biology, Ventura, California (discussion leader).
- 2011 Department of Energy CO2 Fixation Workshop, Annapolis, Maryland.
- 2011 15th International Conference on Biological Inorganic Chemistry, Vancouver, Canada Plenary lecture.
- 2011 Chemistry Department, Oxford University, Oxford England.
- 2010 Gordon Research Conference on FeS Proteins, New London, NH.
- 2010 Chemistry Department, Pacific University.
- 2010 Physics Department, Utah State University.
- 2009 Biochemistry Department, University of California Irvine.
- 2009 Chemistry Department, University of Rochester, Rochester, NY.
- 2009 International Conference on Biological Inorganic Chemistry, Nagoya, Japan (speaker and session chair).

- 2009 Department of Plants, Soils, and Climate, Utah State University.
- 2008 Logan Rotary Club, Logan UT.
- 2008 Metalloenzymes, Nagoya University, Nagoya, Japan.
- 2008 USU Sustainable Energy and Initiatives Conference, Utah State University.
- 2008 Gordon Research Conference, Protein Cofactor, Quinones, and Radicals, Ventura California.
- 2007 Department of Chemistry and Biochemistry, Montana State University, Bozeman Montana.
- 2007 Economic Summit, Whats Goin Down Up North Utah State University Innovation Campus.
- 2007 Utah State University Foundation Board of Directors, April 14, Alumni Center.
- 2007 Department of Chemistry, Boston University.
- 2007 Chemistry Department, Nankai University, China.
- 2007 AC Womens Luncheon, April 2nd, USU Alumni House.
- 2007 Sunrise Sessions, January 12, 23rd floor Wells Fargo Building, Salt Lake City, Utah.
- 2006 College of Natural Resources, University of California Berkeley.
- 2006 Department of Chemistry and Biochemistry, Brigham Young University.
- 2006 2nd Grenoble Inorganic Chemistry Conference, Autrans, France.
- 2006 Radio interview, KCPW (NPR station in Salt Lake City). August 5, 2006, Midday Metro. ([www.kcpw.org/ar](http://www.kcpw.org/ar))
- 2006 Gordon Research Conference on Iron Sulfur Proteins, New London, NH.
- 2006 Metallobiochemistry Summer Symposium, Penn State University.
- 2005 Department of Chemistry, University of Georgia.
- 2005 Department of Chemistry and Biochemistry, Arizona State University.
- 2005 12th International Conference on Biological Inorganic Chemistry (ICBIC), Ann Arbor, Michigan
- 2005 Biotechnology Center, Utah State University, Microbial Fermentation Workshop
- 2005 Department of Chemistry, University of South Florida
- 2005 Department of Chemistry, University of Iowa
- 2005 Gordon Research Conference, Inorganic Reaction Mechanisms
- 2004 Gordon Research Conference, Enzyme Mechanisms
- 2004 Chemistry Department, University of California, Davis
- 2003 Department of Biochemistry, Medical College of Wisconsin, Milwaukee.
- 2002 Gordon Research Conference, Nitrogen Fixation.
- 2002 Second International Conference on FeS Clusters, Marburg, Germany
- 2002 Department of Medicinal Chemistry, University of Utah.
- 2002 Biotechnology Center, Utah State University, Microbial Fermentation Workshop.
- 2002 Department of Biochemistry, University of Missouri-Columbia.
- 2002 American Society for Microbiology National Meeting, Salt Lake City, UT.

- 2001 Biotechnology Center, Utah State University, Microbial Fermentation Workshop.
- 2001 Department of Chemistry, Carnegie Mellon University.
- 2000 Center for Metalloenzyme Studies, University of Georgia, Summer Workshop.
- 2000 Gordon Research Conference, Nitrogen Fixation.
- 2000 American Chemical Society Meeting, San Francisco, CA.
- 1999 12th International Congress on Nitrogen Fixation, Foz du Igauçu, Brazil.
- 1998 Department of Chemistry and Biochemistry, CalState Fullerton.
- 1998 Department of Biochemistry, University of Pennsylvania.
- 1998 Department of Chemistry, University of Utah.
- 1998 Gordon Research Conference, Metals in Biology.
- 1998 Gordon Research Conference, Nitrogen Fixation.
- 1997 Department of Chemistry, Princeton University.
- 1997 Department of Biochemistry, Michigan State University.
- 1997 11th International Congress on Nitrogen Fixation, Paris, France.
- 1997 5th International Congress on Hydrogenases, Albertville, France.
- 1997 Steenbock Symposium, University of Wisconsin, Madison.
- 1997 Department of Biochemistry, University of California-Riverside.
- 1997 Department of Chemistry and Biochemistry, University of California, Los Angeles.
- 1997 Biochemistry Department, Wayne State University.
- 1997 Biochemistry Department, Virginia Polytechnic Institute and State University.
- 1997 Department of Chemistry, California Institute of Technology.
- 1997 Center for Metalloenzyme Studies, University of Georgia.
- 1996 Biochemistry Department, Kansas State University.
- 1996 Metalloprotein Group, University of Nebraska.
- 1996 Gordon Research Conference, Nitrogen Fixation.
- 1995 Department of Physics, Utah State University.
- 1994 Fort Lewis College, Durango, CO.
- 1993 Chemistry and Biochemistry Department, Brigham Young University.
- 1993 Chemistry and Biochemistry Department, Georgetown University.
- 1993 Chemistry and Biochemistry Department, University of North Texas.
- 1993 Biochemistry Department, North Carolina State University.
- 1985 Pacific Slopes Biochemical Conference, Riverside, CA.

## FUNDING

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### *Current*

- 8/15/16-8/14/19 Department of Energy (DE-SC0010687) Nitrogenase reduction of N<sub>2</sub> and CO<sub>2</sub>, PI: L.C. Seefeldt, co-PI: D.R. Dean. Total request: \$350,000 (1 month commitment).
- 8/30/14-8/30/18 Department of Energy (DE-SC0012518) Biological Electron Transfer and Catalysis, Energy Frontiers Research Center, PI: J.W. Peters, co-PIs: L.C. Seefeldt and five others. Total costs: \$700,000 (1 month commitment)
- 11/20/15-11/19/18 Department of Energy, Enzymatic Energy Conversion: Nitrogenase as a Paradigm, PI: S. Raugei, co-PI: L.C. Seefeldt. Total costs: \$200,000 (0.5 month commitment).
- 8/1/17-8/1/21 National Aeronautics and Space Administration, Center for the Utilization of Biological Engineering in Space, PI: A. Arkin, co-PIs: L.C. Seefeldt and 12 others. Total request: \$1 million (1 month commitment)
- 10/1/17-9/30/20 Department of Energy Mechanism of Photochemical N<sub>2</sub> Reduction, PI: P. King, co-PI: L.C. Seefeldt and 2 others. Total request: \$450,000 (0.5 month commitment)

### *Past*

- 2013-2017 Department of Energy, Basic Energy Sciences. Nitrogenase reduction of CO<sub>2</sub> to hydrocarbons. (PI- Seefeldt, coPI-Dean). \$760,000 total costs. 8/15/2013-8/14/2017.
- 2013-2017 Glanbia Foods International. Waste delac to high value products (PI Quinn, CoPI-Seefeldt). \$200,000 total contract. 9/1/2013-8/31/2016.
- 2013-2016 National Science Foundation. Role of the P clusters and FeMo-cofactor in nitrogenase catalysis. (PI Peters, co-PI- Seefeldt) \$450,000 total award. 9/1/2013-8/31/2016.
- 2009-2014 Agriculture Experiment Station, Utah State University. Phototrophic microbe fuel production. (PI - Lance Seefeldt). \$50,000 total cost. 7/1/2009-6/30/2015.
- 2009-2013 National Institutes of Health. Nitrogenase Mechanism (PI. Seefeldt, Co-PI Dean). \$1.3 million total cost. 4/1/2009-3/31/2014.
- 2010-2012 Department of Energy. Algal Biofuels and CO<sub>2</sub> Biosequestration. (PI. Wood; coPIs Seefeldt, Sims, Muhs). \$2.46 million. 7/1/2010-4/15/2013.
- 2009-2012 National Science Foundation. Bacterial Enzyme Systems for Wax Ester Production. (PI. Brett Barney, Univ. of Minnesota, CoPI Seefeldt). \$400,000 total cost. 7/28/2009-4/30/2013.
- 2009-2012 Department of Energy. Extremophilic Microalgae: Advanced Lipid and Biomass Production for Biofuels and Bioproducts (PI. Brent Payton Montana State University; Co-PI Seefeldt, Barney, Viamaajala). \$750,000 total cost. 7/1/2009-9/30/2012.
- 2009-2011 Department of Energy. Multifunctional Solar Energy Systems (PI. Jeff Muhs, CoPIs Wood, Seefeldt, Sims). \$868,660 total cost. 9/30/2009-10/31/2010.
- 2009-2010 Uintah Basin Mitigation Project. Carbon dioxide capture and water remediation. (PI. Seefeldt). \$75,000 total cost. 10/1/2009-9/30/2010.
- 2009-2010 Defense Advanced Research Projects Agency (DARPA). The Development of Algae-based JP8 Through Industry System Integration. (PI. General Atomics; coPI Muhs, Wood, Seefeldt). \$500,000 total cost. 1/5/2009-6/1/2010.
- 2007-2010 National Science Foundation. Acquisition of an EPR spectrometer (PI. Seefeldt; coPI Berreau, Ensign, Aust). \$173,445 total cost. 9/1/2007-8/31/2010.

- 2007-2010 Utah Science, Technology, and Research (USTAR) initiative. Biofuels Research Team (PI. Byard Wood; co-PI Lance Seefeldt). \$6.8 million total cost.
- 2007-2010 Agriculture Experiment Station, Utah State University. Production of Biodiesel from Utah Safflower. (PI. Brett Barney, Co-PI Lance Seefeldt). \$50,000 total cost.
- 2004-2009 National Institutes of Health Grant R01-GM59087. Nitrogenase Mechanism (PI. Seefeldt, co-PI Dennis R. Dean). \$1.5 million total cost.
- 2001-2004 National Science Foundation Grant MCB-0090187. \$359,672. Nucleotide-Dependent Energy Transduction in Nitrogenase.
- 1999-2004 National Institutes of Health Grant RO1-GM59087. \$970,000. Nitrogenase Mechanism. (PI. Seefeldt, co-PI Dennis R. Dean).
- 1997-2001 National Science Foundation Grant MCB-9722937. \$315,000. Nucleotide-Dependent Signal Transduction in Nitrogenase.
- 1998-2000 Utah State Agricultural Experiment Station Grant. \$15,000. Substrate Interactions with Nitrogenase.
- 1996-1997 Utah State Agricultural Experiment Station Grant. \$15,000. Increasing the Energy Efficiency of Biological Nitrogen Fixation by Genetic Engineering.
- 1996 National Science Foundation Research Experience For Undergraduates Grant. \$4,000. Summer Salary for Talmage Shill and Alicia Backlund.
- 1994-1997 National Science Foundation Grant MCB-9315835. \$312,000. MgATP Energy Transduction in Nitrogenase.
- 1995 Office of the Vice President for Research, Utah State University. \$15,000. Defining the Mechanism of H<sub>2</sub> Activation and Electron Transfer in the NiFe Hydrogenase from *Alcaligenes eutrophus*.
- 1995 National Science Foundation Research Experience For Undergraduates Grant. \$4,000. Summer Salary for Sean Johnson.
- 1994 National Science Foundation Research Experience For Undergraduates Grant. \$4,000. Summer Salary for Scott Woodhouse.
- 1994 High School Teacher Research Fellowship Program, American Society for Biochemistry and Molecular Biology. Logan High School Biology Teacher Mindy Bell. \$6,000. Summer Salary and supplies.
- 1994 National Science Foundation, Office of Science and Technology Infrastructure. \$167,000. Purchase of an EPR Spectrometer. PI: Vernon Parker. Co-PIs: Lance Seefeldt, Scott Ensign, Rick Holz, Ann Aust, Danny Blubaugh, Tom Grover.
- 1993 Brookhaven National Laboratories, National Synchrotron Light Source. Faculty-Student Research Support Program Award. \$4,000. Travel and expenses for LCS and undergraduate student David Cook to BNL, Upton, NY.
- 1993 Brookhaven National Laboratories, General User Award for Beam Time Allocation. Robert Scarrow and Lance Seefeldt. X-ray beam time. XAS of the EPR-Silent Nickel in NiFe Hydrogenase from *Alcaligenes eutrophus*.

## **SOCIETY MEMBERSHIPS**

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- 1995-present Member, American Chemical Society.
- 1992-1997 Member, The Protein Society.

- 1992 Member, American Society for Biochemistry and Molecular Biology.
- 1989-present Member, American Association for the Advancement of Science.

## **GRADUATE STUDENTS DIRECTED**

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- 2014- Derek Harris, Research Assistant.
- 2013- Rhesa Ledbetter, Research Assistant.
- 2013-2015 Andrew Rasmussen, Research Assistant.
- 2012- Nimesh Khadka, Research Assistant.
- 2012- Sudipta Shaw, Research Assitant.
- 2011-2014 Alex McCurdy, Research Assistant.
- 2011-2013 Shannon Wendroth, Research Assistant.
- 2010-2011 Boyd Inglet, Research Assistant.
- 2010-2012 Valerie Godfrey, MS degree.
- 2009-2013 Robert Willis, Research Assistant.
- 2007-2013 Dr. Zhiyong Wang, Research Assistant.
- 2006-2010 Brad Wahlen, Ph.D.
- 2006-2013 Karamatulla Danayl, Research Assistant.
- 2003-2009 Alejandro Pabon, MS degree.
- 2003-2007 Nate Maeser, MS Biochemistry.
- 2002-2006 Jammi McClead, MS. (now Research Associate, Ohio State Univ).
- 2000-2005 Robert Igarashi, Ph.D. Biochemistry (now Assistant Professor, University of Central Florida).
- 2001-2002 Vidhya Naringin, Research Assistant.
- 1997-2001 Wu, MS Biochemistry (now Graduate Student in Computer Science at Utah State University).
- 1997-2001 Jeannine M. Chan, Ph.D. Biochemistry (now Assistant Professor, University of the Pacific).
- 1994-1998 Matthew James Ryle, Ph.D. Biochemistry (now Research Scientist, IDEX Pharmaceuticals, Maine).
- 1994-1999 William N. Lanzilotta, Ph.D. Biochemistry (now Associate Professor of Biochemistry, University of Georgia, Athens, GA).

## **UNDERGRADUATES DIRECTED**

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- 2010-2015 Mike Morgan, Biochemistry major.
- 2012-2013 Ryan Carlsen, Biochemistry major.
- 2012-2013 Andy Higham, Biochemistry major.
- 2012-2013 Mariah Ogborn, Biochemistry major.
- 2010-2012 Neal Draper, Biological Engineering major.
- 2010-2012 Christian Cannell, Biochemistry major.

- 2009-2012 Lynsey Talbot, Chemistry Teaching major.
- 2005-2008 Alma Jones, Biochemistry major.
- 2006-2008 Whitney Oswald, Biochemistry major.
- 2004-2005 Ian Swerdt, Chemistry major
- 2004-2006 Mike Yurth (URCO recipient in 2004) (now Univ. Michigan Dental School).
- 2004-2006 Whitney Braugh, Chemistry major
- 2002-2004 Matt Fowers, Chemistry major.
- 2002-2003 Tyler Shiner, Chemistry major.
- 2002-2003 Nathen Maeser, Chemistry major.
- 2001-2002 Kevin Gilbert, Chemistry major.
- 2000-2001 Sarah Wheat, Chemistry major.
- 2000-2002 Jeremy Gibbons, Chemistry major.
- 1997-2000 Eric Westerberg, Chemistry major.
- 1997-2000 David Duke, Biology major.
- 1996-1999 Alicia Backlund, Chemistry major.
- 1995-1997 Sterling Nesbit, Chemistry major.
- 1995.1996 Sean Johnson, Chemistry major (Ph.D. in Biochemistry from Duke) (now Assistant Professor, Utah State University).
- 1997-2000 Talmage Shill, Life Sciences major (M.D. from the Medical School at Virginia Commonwealth University).
- 1995-1996 Cally Duncan, Chemistry major, Fort Lewis College, Colorado.
- 1994-1995 Scott Woodhouse, Chemistry major (Ph.D. in Biochemistry from Duke).
- 1993-1994 Kate Decker, Chemistry major.
- 1993-1994 David Cook, Chemistry major (M.D., Johns Hopkins School of Medicine).

## POSTDOCTORAL SCIENTISTS

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- 2014- Dr. Zhiyong Yang
- 2015- Dr. Pathinan Paengnakorn
- 2011-2013 Dr. Simon Duval, Grenoble France.
- 2013-2015 Dr. Andrew Fielding.
- 2011-2012 Dr. Brad Wahlen. Senior Scientist, FL Schmidt Co.
- 2003-2009 Dr. Brett Barney (USDA Postdoctoral Fellow). Assistant Professor of Biotechnology, University of Minnesota.
- 2000-2002 Dr. Paul Benton (now Postdoctoral Associate, Montana State University).
- 1998-2000 Dr. Jennifer Huyett.

- 1995-1997 Dr. Madeline Rasche, NSF Postdoctoral Fellow (Associate Professor of Biochemistry, Calif. State Univ. Fullerton).
- 1996-1997 Dr. Alisa Roddick (currently a postdoc in New Zealand).

#### **VISITING SCIENTISTS**

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- 2008, 2009 Dr. Kyle Craig, Chemistry Department, Walla Walla University, Washington.
- 2000 Dr. Krzysztof Z. Walczak, Assistant Professor, Institute of Organic Chemistry and Technology, Silesian Technical University, Poland.
- 1997-2000 Dr. Jason Christiansen, Biochemistry Department, Virginia Tech.
- 1993-1996 Dr. Jack Chen, University of Georgia, Department of Biochemistry.