

Engineering Morphology and Secretion to Enhance the Productivity of Fungal Fermentations

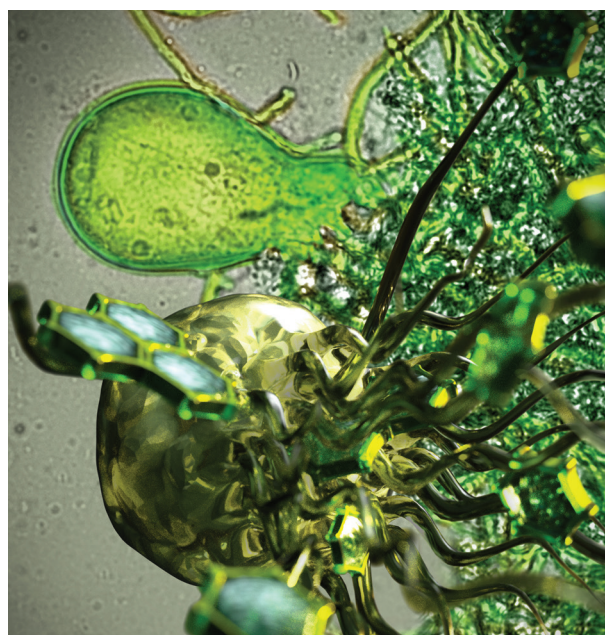
Steven Harris (PI)¹, Mark Marten (Co-PI)²; ¹University of Nebraska – Lincoln, ²University of Maryland – Baltimore County

FECB: A Functional Encyclopedia of Cyanobacteria - Building the Knowledge Framework for an Enhanced Understanding of Carbon and Nitrogen Cycling

Matthias Hess (PI)¹, Richard Castenholz², Trent Northen³, Peter Larsen⁴, Kevin Keegan⁴, Stephen Lindemann, Anantharaman Kalyanaraman¹, Vincent Lombard⁶, Bernard Henrissat⁶; ¹Washington State University, ²University of Oregon, ³Lawrence Berkeley National Laboratory, ⁴Argonne National Laboratory, ⁵Pacific Northwest National Laboratory, ⁶Architecture et Fonction des Macromolécules Biologiques Laboratory

Development of Novel Approaches to Target Microbial Drivers of C Cycling in Soil Aggregates

Kirsten Hofmockel (PI), Adina Howe (Co-PI), Racheal Erb, Sheryl Bell, Montana Smith; Iowa State University



FY 2014, Michelle O'Malley: Anaerobic gut fungi colonize biomass, and secrete enzymes that release free sugars into their environment. (Artistic rendering of the fungi by UCSB engineering graphic designer Peter Allen)

Organelles Promoting High Level Terpenoid Biosynthesis in Filamentous Fungi

Harold Kistler (PI)¹, Claudia Schmidt-Dannert (Co-PI)²; ¹United States Department of Agriculture – Agricultural Research Service Cereal Disease Laboratory, ²University of Minnesota

Identification and Regulation of Cellulases within Novel Anaerobic Gut Fungi

Michelle O'Malley; University of California, Santa Barbara

Functional Genomics of Moss-Cyanobacteria Interactions in Boreal Forest Ecosystems

Philip Weyman (PI)¹, Chris Dupont (Co-PI)¹, Ulla Rasmussen²; ¹J. Craig Venter Institute, ²Stockholm University



FY 2017, Virginia Rich of The Ohio State University: Plant-Microbial-Permafrost Carbon Dynamics by Parallel High-Resolution Organic Matter and Microbial Meta-omics. Robert Jones seen here drilling for permafrost samples. (Credit: Moira Hough)

The Facilities Integrating Collaborations for User Science (FICUS) initiative was established three years ago between EMSL and the DOE Joint Genome Institute (JGI) to encourage and enable researchers to more easily integrate the expertise and capabilities of the two Office of Science national scientific user facilities into their research. The FICUS calls between EMSL and JGI represent unique opportunities for researchers to combine the power of genomics and molecular characterization in one proposed research project.

The featured summaries provide descriptions of active or completed projects from this collaborative effort.

FY 2019

Microbial Metabolic Activity and Biogeochemical Reaction Networks in Redox Cycled Alluvial Systems

Kristin Boye; Stanford Linear Accelerator Center

Validation of the Transfer of Metabolic Models From *Aspergillus niger* to Other Fungi Using an Orthology-Based Approach

Ron de Vries; Westerdijk Fungal Biodiversity Institute

Probing Microbial Interactions and Coordinated Trophic Responses in Biological Soil Crusts

Erik Hom; University of Mississippi

Linking Phosphorus and Carbon in Rhizosphere Nutrient Cycling

James Moran; Pacific Northwest National Laboratory

Deciphering the Structure & Function of Secondary Metabolites from Anaerobic Fungi

Michelle O'Malley; University of California, Santa Barbara

Plant Litter Degradation and Microbial Defense by Host-Specific Fungal Endophytes

Ryoko Oono; University of California, Santa Barbara

Interactive Mechanisms of Mineral Dissolution by a Microbial Consortia

Yeala Shaked; Hebrew University of Jerusalem

Epigenetic Regulation of Anaerobic Fungi for Increased Lignocellulose Degradation

Kevin Solomon; Purdue University

Understanding and Harnessing the Robustness of Undomesticated *Yarrowia lipolytica* Strains for Biosynthesis of Designer Bioesters

Cong Trinh; University of Tennessee

Consequences of Plant Genetic Variation and the Surrounding Microbiome on Nitrogen Fixation

David Weston; Oak Ridge National Laboratory

Hydrobiogeochemical Feedbacks Across Seasonal and Decadal Time-Scales: Implications for Solute Fate and Transport in Riverbed Ecosystems

Michael Wilkins; The Ohio State University

Experimental Impacts of Climate Warming and Ocean Acidification on Metabolic Function and Blue Carbon Accumulation by Eelgrass

Richard Zimmerman; Old Dominion University

FY 2018

Combining High Resolution Organic Matter Characterization and Microbial Meta-Omics to Assess the Effects of Nutrient Loading on Salt Marsh Carbon Sequestration

Jennifer Bowen; Northeastern University

Linking Proteogenomics, Metabolomics, and Soil Organic Chemistry of Tropical Wetlands to a Soil Nutrient Cycling Model

Melanie Mayes; Oak Ridge National Laboratory

Detecting Seismically-Sustained Deep Subsurface CH₄-Cycling Chemolithoautotrophic Microbial Communities Using Multi-Omic Analyses and NanoSIMS

Tullis Onstott; Princeton University

Investigating the Carbon Cycling Implications of Changing Microbial Leaf Litter Decomposition across a Permafrost Thaw Gradient

Scott Saleska; University of Arizona

**Scaling Molecular Mechanisms of Mycorrhizal-
Decomposer Interactions to Emergent Ecosystem
Carbon Balance**

Jennifer Talbot; Boston University

**Tracking Switchgrass Photosynthate via ^{13}C
Pulse-Chase into the Rhizosphere Microbiome
and Metabolome**

Lisa Tiemann; Michigan State University

FY 2017

**The Impacts of Nitrogen Availability and Seasonal
Dynamics on Plant-Microbial Interactions
Affecting C and N Cycling in Coniferous Forest Soils**

Petr Baldrian; Institute of Microbiology ASCR

**Systems Analysis of Grass Secondary Cell Wall
Development and Regulation for Biofuel Production**

Laura Bartley; University of Oklahoma

**Combined 'Omics Approaches for the Study of
Ectomycorrhizal Symbiosis between Suillus and
Pinaceae, with Emphasis on Their Role in
Nutrient Cycling**

Hui-Ling Liao; Duke University

**Global Warming Induced Salinity Shifts: Metabolic
Responses by Algal-Bacterial Consortia**

Rose Ann Cattolico; University of Washington

**Something Old, Something New: Systems-Level
Insights into Plant-Microbial-Permafrost Carbon
Dynamics by Parallel High-Resolution Organic
Matter and Microbial Meta-omics**

Virginia Rich; The Ohio State University

**Molecular Mechanisms Underlying Changes in the
Temperature Sensitive Respiration Response of
Forest Soils to Long-Term Experimental Warming**

Jeffrey Lawrence Blanchard; University of
Massachusetts Amherst

**Understanding Conversion of Biomass-Derived
Carbon into Lipids and Terpenoids in the
Oleaginous Yeast *Rhodospiridium Toruloides***

Jeffrey Michael Skerker; University of California,
Berkeley

**The Role of Priming Effects on the Conversion
of Blue Carbon to CO_2 in the Coastal Zone**

Thomas Stephen Bianchi; University of Florida

**Deciphering Controls on Plant Decomposition in
Arctic Ecosystems: Identifying Unknown Microbial
Condensed Tannin Degradation Pathways**

Kelly Catherine Wrighton; The Ohio State University

**Metabolic Constraints on Organic Matter
Decomposition and Metal Cycling in
Sediment Deposits**

Scott Fendorf; Stanford University

FY 2016

**Specialized Ribosomes: A New Frontier
in Gene Regulation**

Deborah Bell-Pedersen (PI), Matthew Sachs;
Texas A&M University

**3D Reality Check: Developing Structural Support
for Predicting Microbial Function and Interpreting
Microbial "Omics" Data**

Zoe Cardon (PI), Joseph Vallino (Co-PI),
Margrethe Serres; Marine Biological Laboratory

**Nitrogen Fixation in Populus: Identification and
Localization of the Key Diazotrophs in Planta**

Sharon Doty (PI), Soo-Hyung Kim (Co-PI); University
of Washington

**Building the Phage-Host-Environment
Interaction Data to Scale from Genes-to-
Ecosystems: Towards Predictive Modeling of
Wild Microbial and Viral Community Dynamics**

Melissa Duhaime (PI)¹, Matthew Sullivan²;
¹University of Michigan, ²University of Arizona

**Genomes to Dynamic Decay Communities:
Understanding Fungal Interactions during Early
Decomposition Events in Natural
Lignocellulosic Substrate**

Dan Eastwood (PI)¹, Ronald de Vries²,
Jonathan Schilling³, Mila Mäkelä (Co-PI)⁴,
Kristina Hildén⁴, Lynne Boddy⁵; ¹Swansea University,
²CBS-KNAW Fungal Biodiversity Centre, ³University of
Minnesota, ⁴University of Helsinki, ⁵Cardiff University

**A Rhizosphere-Scale Investigation of the
Relationship between Plant Productivity and
Methane Emissions from Wetlands**

Rebecca B. Neumann (PI), Heidi L. Gough,
Ludmila Chistoserdova, David A. C. Beck; University
of Washington

**Fluorescence-Based Cell Sorting and
Targeted Proteomic Analysis of Active
Methane-Oxidizing Syntrophic Consortia
from Environmental Samples**

Victoria Orphan; California Institute of Technology

**Integrated Omics Analyses of a Populus
Pedigree for Crop Improvement**

Chongle Pan (PI), Jingui Chen (Co-PI),
Wellington Muchero; Oak Ridge National Laboratory

FY 2015

**Integrated Biogeochemical Modeling of
Microbial Consortia Mediating Anaerobic
Oxidation of Methane in Dynamic Methane
Hydrate-Bearing Sediments**

Frederick S. Colwell (PI), Michael Graw; Oregon
State University

**Decoding DOM Degradation: How Does Carbon
Source and Sunlight Exposure Alter Microbial
Metabolism and Expression of Genome-Encoded
Metabolic Degradation of Permafrost
Organic Matter?**

Byron Crump (PI)¹, Rose Cory (Co-PI)², George Kling²;
¹Oregon State University, ²University of Michigan

**Mapping the Metabolism of Nutrient and Carbon
Exchange in the Plant-Microbe Symbiosis**

Jonathan Cumming (PI)¹, Peter Larsen (Co-PI)²,
Shalaka Desai², Philip Laible², Frank Collart²,
Stephen DiFazio¹; ¹West Virginia University, ²Argonne
National Laboratory

**Dissecting Intraspecies Diversity in Fungal
Wood Decay**

Ronald de Vries (PI)¹, Milä Makelä (Co-PI)²,
Kristina Hildén²; ¹CBS-KNAW Fungal Biodiversity
Centre, ²Argonne National Laboratory

**Sensing External Metals by Outer Membrane
Beta-Barrel Proteins**

Thomas DiChristina; Georgia Institute of Technology

**Uncovering the Composition and
Function of the Aquatic Microbiome
for Duckweeds**

Sarah Lebeis (PI)¹, Eric Lam (Co-PI)²; ¹University of
Tennessee, ²Rutgers University

**Quantifying Differential Expression and
Identifying Bottlenecks in Methanogenic Pathways**

Zaida Luthy-Schulten (PI)¹, William Metcalf (Co-PI)¹,
Taekjip Ha¹, Rudolf Thauer², Elizabeth Villa³,
Joseph Peterson¹, Piyush Labhsetwar¹; ¹University of
Illinois at Urbana-Champaign, ²Max Planck Institute for
Terrestrial Microbiology, ³University of California,
San Diego

**Elucidating the Influences of Engineered
N-Glycosylation Motifs in Bacterial Biomass
Hydrolyzing Enzymes upon Heterologous and
Native Gene Expression, Secretion and Degradation
in *Aspergillus Niger***

Jon Magnuson (PI)¹, John Gladden²; ¹Pacific Northwest
National Laboratory, ²Joint BioEnergy Institute

**Systems-level Insights into Carbon Transformations
in Thawing Permafrost by Parallel High-resolution
Organic Matter and Microbial Community
Characterizations**

Virginia Rich (PI)¹, Gene W. Tyson (Co-PI)², Jeff Chanton
(Co-PI)³, Malak Tfaily (Co-PI)⁴, Scott Saleska (Co-PI)⁵,
Ruth Varner (Co-PI)⁶; ¹The Ohio State University, ²Uni-
versity of Queensland, ³Florida State University, ⁴Pacific
Northwest National Laboratory, ⁵University of Arizona,
⁶University of New Hampshire

**Coupling Microbial Communities to Carbon
and Contaminant Biogeochemistry in the Ground-
water-Surface Water Interaction Zone**

James Stegen (PI)¹, James Fredrickson (Co-PI)¹,
William Nelson¹, Eric Roden²; ¹Pacific Northwest
National Laboratory, ²University of Wisconsin, Madison

**Integrated Genomic/Transcriptomic/Secretomic
Study of Plant-Fungal Interactions between Pines
and Their Symbiotic Ectomycorrhizal Fungi in the
Mushroom Genus *Suillus***

Rytas Vilgalys (PI)¹, Jennifer Talbot (Co-PI)², Hui Ling
Liou¹, John W. Taylor³, Thomas D. Bruns³, Kabir G. Peay⁴;
¹Duke University, ²Boston University, ³University of
California, Berkeley, ⁴Stanford University

**Microbial Controls on Biogeochemical Cycling in
Deep Subsurface Shale Carbon Reservoirs**

Kelly Wrighton (PI), Michael Wilkins (Co-PI),
Paula Mouser, Anne Booker; The Ohio State University

FY 2014

**Mapping Soil Carbon from Cradle to Grave: Using
Comparative Transcriptomics, Proteomics and
Metabolite Analysis to Identify the Microbial
Blueprint for Root-Enhanced Decomposition of
Organic Matter**

Mary K. Firestone (PI)¹, Jennifer Pett-Ridge²,
Eoin Brodie³, Erin Nuccio^{1,2}, Mary Lipton⁴, Tom Metz⁴;
¹University of California, Berkeley, ²Lawrence Livermore
National Laboratory, ³Lawrence Berkeley National
Laboratory, ⁴Pacific Northwest National Laboratory

**Genome-enabled Investigations of the Role of
Secreted Proteins and Reactive Metabolites in
Carbon Degradation by Pure and Mixed
Ascomycete Fungal Communities**

Colleen Hansel (PI)¹, Cara Santelli (Co-PI)², Carolyn Zeiner³;
¹Woods Hole Oceanographic Institution, ²University of
Minnesota, ³Harvard University