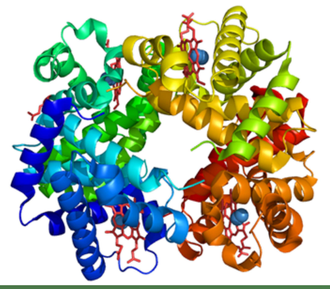

Enzymes in the Environment Research Coordination Network

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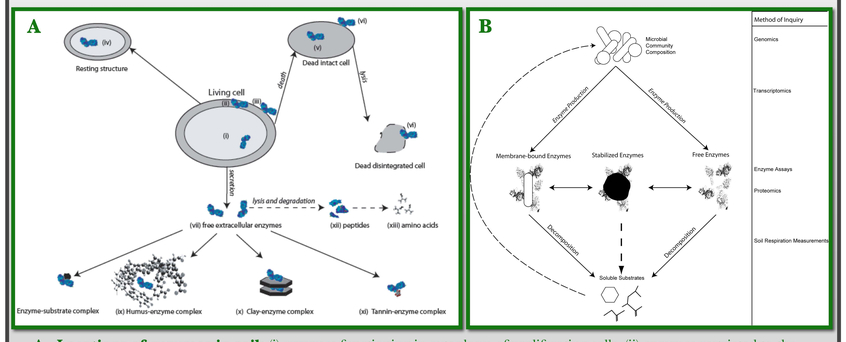
Purpose

To **bring together scientists, students and educators** interested in extracellular enzymes in the environment.

Why an Environmental Enzymes RCN?

Extracellular enzymes produced by bacteria and fungi are involved in innumerable biogeochemical processes and are central to providing services to terrestrial and aquatic ecosystems. However, our understanding of enzyme production, stabilization & turnover, and in-situ activity is constrained by:

1. limited methods for measuring in-situ activity;
2. limited discourse across disciplinary and ecosystem boundaries; and
3. limited synthesis of current research into an integrated conceptual framework leading into ecosystem models.



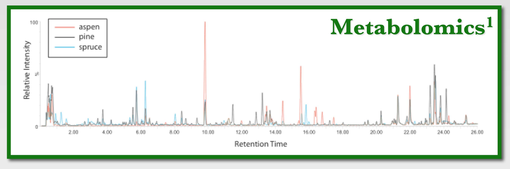
A. Locations of enzymes in soil: (i) enzymes functioning in cytoplasm of proliferating cells, (ii) enzymes restricted to the periplasmatic space of proliferating Gram(-) bacteria, (iii) enzymes attached to outer surface of viable cells, (iv) enzymes within nonproliferating cells such as fungal spores, protozoa cysts, plant seeds and bacteria endospores, (v) enzymes attached to dead cell and cell debris, (vi) enzymes leaking from intact cells or released from lysed cells, (vii) free extracellular enzyme (EE)s in soil pore water, (viii) enzymes associated temporarily in soluble or insoluble enzyme-substrate complexes, and (ix) enzymes complexed with humic colloids, (x) enzymes sorbed to external or internal surfaces of clay minerals, (xi) enzymes bound to condensed tannins. EE can be degraded abiotically or through activity of proteolytic enzymes into (xii) peptides and then degraded by peptidases into their constituent amino acids (xii). From: Wallenstein & Burns, in press).

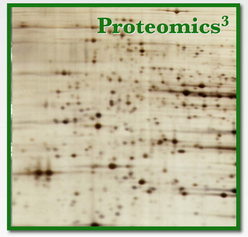
B. Conceptual diagram of microbial enzyme production, stabilization & activity. Emerging technologies to examine each component of environmental enzymology are indicated by the text on the right side. From: Wallenstein & Weintraub (2008).

Unanswered Questions in Environmental Enzymology

1. What factors control microbial production of enzymes?
2. How is extracellular enzyme production regulated at the cellular and population level?
3. How much activity comes from stabilized enzymes?
4. Does enzyme turnover rate differ among environments?

Emerging Technologies





1 Chromatogram from Wallenstein, Lewis & Steltzer (unpublished data)

2 Imprints and soil profiles from root windows in interior Douglas-fir stands near Barriere, British Columbia, Canada. (a) phosphatase imprint; (b) aminopeptidase imprint; (c) soil image overlain with same imprint; (d) image of soil profile; (f) b-glucosidase imprint and (e) associated soil image; (h) chitinase imprint and (g) associated soil image. All images are at the same scale. From: Dong et al. 2007. Reproduced with permission from S. Grayston

3 Gel from Wallenstein et al. (unpublished data)

Long-term Objectives

1. To develop an international, interdisciplinary community of environmental enzyme researchers.
2. To improve our understanding of biotic & abiotic controls on enzyme production, stabilization, turnover and in situ activity.
3. To standardize and advance enzyme methodology to make lab-to-lab data comparisons more meaningful.

Services & Resources

Website

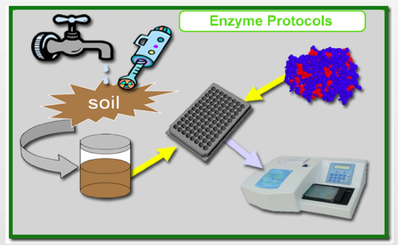
Here, you'll find news, workshop & conference announcements, funding opportunities & discussion forums.

http://enzymes.nrel.colostate.edu

Protocol Repository

To share a protocol, send it to: enzymes@nrel.colostate.edu.

Also, we've created an "Experimental Notes" section for recording things that went wrong and what you've learned creating protocols and doing experiments.



Activities to Date

- Recruited more than 200 members to the RCN.
- First round of Research Exchanges funded
- Planning for "International Workshop on Environmental Proteomics" in January 2010
- Planning for "Enzymes in the Environment" workshop in March 2010

References

Dong, S., D. Brooks, M. D. Jones & S. J. Grayston. 2007. A method for linking in situ activities of hydrolytic enzymes to associated organisms in forest soils. SBB 39: 2414-2419.

Wallenstein, M.D. & R. Burns. 2009. Ecology and biochemistry of soil enzymology. In: Methods of Soil Enzymology, R. Dick (ed.). In Press.

Wallenstein, M.D. & M.N. Weintraub. 2008. Emerging tools for measuring and modeling the in situ acitivity of extracellular enzymes. SBB 40: 2098-2106.