Changes in litter chemistry during decomposition: patterns and pathways

Co-organizers: Becky A. Ball and Kyle G. Wickings

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Decomposition of plant litter is a fundamental biogeochemical process, integral to energy and nutrient cycling and soil formation. While many studies have investigated how litter chemical content relates to its decomposition, most focus only on initial chemistry as an indicator of how litter will behave throughout decomposition. Such studies have improved our predictions of decomposition dynamics, including decay rate; however, our understanding of the patterns of changes in litter chemistry during decay is incomplete. Many decomposition studies, particularly within the LTER network, have yielded rich amounts of data concerning the chemical content of litter throughout decomposition, but it remains unclear whether all aspects of litter chemistry follow consistent patterns throughout decomposition across systems (e.g., forest, desert, agriculture, etc.). It is also unclear whether such changes in chemistry throughout decomposition will have a meaningful influence on litter decay rates, or whether initial litter chemistry is the main determinant. During this working group session, participants discussed the environmental factors that influence litter chemistry during decomposition and brainstormed questions and testable hypotheses about changes in litter chemistry, particularly paradigms in (a) lignin dynamics and (b) litter chemical convergence over time. In preparation for the session, the co-organizers had identified 59 studies from 16 sites in the LTER network that measured some aspect of litter chemistry during decomposition. Using this information as a basis, we generated a core working group consisting of investigators from 6 LTER sites that will compile available data to understand the nature of changes in litter chemistry over decomposition and identify whether there are similar patterns across systems. With existing LTER data, we will test for convergence over time within particular (reported) chemical fractions (e.g., C:N, lignin) over stages of mass loss, considering soil CN, climate, and biota across sites. For litters with different initial chemistries, we will ask whether litter chemistry changes throughout decay in a parallel manner based on initial chemistry (as assumed by so many) or whether all decomposing litter converges on similar chemical properties over time. Further, we will also investigate how these patterns relate to different rates of decomposition and decomposer communities across systems, and identify the environmental drivers that influence the patterns and temporal variability in litter chemistry during decomposition. By using long-term, cross-site data, we will significantly expand our understanding of the nature and importance of litter chemistry changes throughout decomposition, thus informing the design of future experiments. To achieve these goals, the co-organizers are preparing a LTER Cross-site Synthesis Working Group Grant Proposal that will allow the core working group to reconvene in the spring of 2013 to analyze and synthesize the data compiled by each participant and prepare a synthesis manuscript for peer-reviewed publication.