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Preface

Biogeochemical Gradients: Microbes, Measurements, and Modeling

Biogeochemical gradients are often zones that exhibit the most chemical and/or biological activities within a particular system. Moreover, the fate and transport of elements and the distribution of organisms are heavily influenced by biogeochemical gradients. On a larger scale such as a forest ecosystem, gradients can have significant impacts on overall processes at the km resolution. On a finer scale, gradients within a microbial mat for example can control diffusion of specific elements within a mm. There are many questions that can be asked about how gradients are established and persist within nature. However, fundamental to any biogeochemical gradient is the rate of a reaction occurring along a specific transect. Currently, many important parameters and processes that control the reaction rates in gradients are not known and/or are difficult to measure. Therefore, there is a great need to explore new ideas and approaches to investigate the role of gradients in biogeochemistry.

This special issue on biogeochemical gradients is a culmination of international activities that brought together scientists from microbiology, hydrology, and geochemistry to study biogeochemical processes along gradients. This issue has its roots in the first German-American Workshop on Biogeochemical Gradients at the University of Tuebingen, Germany in May 2005. The group agreed that additional discussion was required to fully explore the nature of gradients in biogeochemistry. As a result, a special session was held at the General Meeting for the American Geophysical Union in San Francisco, CA, December 2005. The special session brought together an interdisciplinary group of scientists that addressed topics such as: how temporal and spatial scales and spheres of microbial activities influence physical/chemical gradients on larger scales; method development to distinguish between abiotic and biotic contributions to redox processes; fundamental biological processes that influence gradients of elements such as Fe, As, Se, Cr and U; identifying functional genes as markers and indicators of redox processes; improvement of culture-dependent techniques to identify and characterize microbial populations inhabiting redox gradients; the integration of chemical and biological measurement techniques; gradient geometry and its impact for reaction dynamics; model development to predict processes below and above the scale of observation (microbe vs. catchment); the development of well characterized controlled field sites to identify and to simulate the laboratory at a field scale; the use of new and existing tools to quantify both electron acceptor and donor at the same scale; the use of chemically reactive surrogates to characterize gradient processes in situ; and the effects of transient flux changes on activities in gradients.

The papers presented in this special issue represent a subset of the topics reported at the December 2005 AGU special session. Research papers in this issue include field studies on Fe and S biogeochemical cycling in wetlands and salt marshes, heavy metals, ammonium and organic contaminant gradients in natural and contaminated sites along with water fluxes in watersheds. We hope that you will enjoy this special issue.

Danielle Fortin
Department of Earth Sciences,
University of Ottawa,
140 Pasteur Street, Ottawa,
Ontario, Canada K1N 6N5
E-mail address: dfortin@uottawa.ca

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Thomas Pichler
University of South Florida, Geology Department, 4202 East Fowler Avenue SCA 528, Tampa, FL 33620, USA

Chad Saltikov
Environmental Toxicology, University of California, Santa Cruz, CA 95064, USA

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