

## Frontiers in Soil Science: Technology and the Information Age

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Contributions in soil science research have immensely benefited humankind, including enhanced food production and the quality of our environment. This overview paper focuses on recent breakthroughs in elucidating soil biogeochemical processes in soils and other natural materials and delineates frontiers for the present decade and beyond. With the advent of state-of-the-art analytical techniques, some of which are synchrotron-based (e.g., X-ray absorption fine structure spectroscopy, XAFS) one can elucidate reaction mechanisms at small scale. The use of small scale techniques in environmental research has resulted in a new multidisciplinary field of study that soil scientists are actively involved in – molecular environmental science. This has been one of the major advances in the soil and environmental sciences over the past decade. Undoubtedly, the molecular characterization of microenvironments and interfacial reactions will become increasingly significant in understanding the interactions between chemistry, physics, and biology in natural environments.

Along with molecular scale approaches, the use of advanced computational technologies and development of multi-scale predictive models will play prominent roles in helping soil scientists address a number of research frontiers including: speciation of contaminants in heterogeneous systems; mechanisms of microbial transformations; the connection between the environment and human health; and development of effective remediation and waste management strategies.