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**CONTAMINATED SOILS, SEDIMENTS, WATER,
AND ENERGY**

Volume 15

Selected manuscripts from the 25th Annual International Conference on
Soils, Sediments, Water and Energy

University of Massachusetts Amherst
October 19 – 22, 2009

**CONTAMINATED SOILS, SEDIMENTS, WATER,
AND ENERGY
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**Bioremediation
Heavy Metals
Modeling
Pesticides
Phytoremediation
Radionuclides
Remediation
Risk Assessment
Sediments
Site Assessment**

Edited by

Paul T. Kostecki
Edward Calabrese
James Dragun

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Foreword

In the Connecticut River Valley, autumn foliage and the sequence of passing cold fronts sweep away summer nostalgia and kick-start thoughts of winter and even that first unformed but undeniable anticipation of green shoots and warm weather waiting at the far side. And, for the past 25 years, autumn has also meant the annual International Conference on Soils, Sediments, Water and Energy in Amherst. It is not simple coincidence that the Conference is one of the most forward-thinking gatherings of scientists, engineers, and environmental practitioners. Our academic training means that autumn is a regular time of intellectual renewal and professional excitement. For many of us, our Circadian clocks peak in autumn—we do our best thinking while leaves are in high color and the air is fresh and dry.

It is not surprising that the Conference proceedings have demonstrated, year after year, that emerging ideas and new and productive concepts can be generated by participants in an institution like the Autumn Conference. And 2009 was no exception. As you peruse the Table of Contents, keep in mind how innovative our inquiries into emergent fields such as bioremediation, phytoremediation, and chemical remediation are, and how our deliberations keep mundane-sounding, but critically important topics such as heavy metals, modeling, pesticides, risk assessment, sediments, and site assessments fresh and in the forefront.

There were more than 140 presentations at the 2009 Conference. The best and the brightest are in your hands now, in the pages of this volume. As you leaf through these proceedings, we hope you resolve to join us next year, as the Conference enters its second quarter-century. Our collective efforts have made this conference an annual treasure. We'll see you in 2010!

Dave Ludwig
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About the Editors

Paul T. Kostecki's professional career has focused on research, education and training in environmental contamination with an emphasis on human and ecological risk assessment and risk management. His work includes soil ingestion estimates for children and adults; establishment of scientifically sound cleanup levels for soil; bioavailability of soil contaminants; fish as toxicological models for contamination assessment; and assessment and management of petroleum contaminated soils. Dr. Kostecki has developed and conducted over 45 conferences, workshops and courses both nationally and internationally, and has made presentations at over 100 national and international meetings. Since 1985, his conference at the University of Massachusetts Amherst on Contaminated Soils, Sediments and Water has attracted over 10,000 environmental professionals from over 40 countries. Dr. Kostecki has published over 100 articles and reports, co-edited/co-authored 25 Books and secured over \$10M in research support.

Dr. Kostecki co-created the Association for Environmental Health and Sciences (AEHS) in 1989 and served as its Executive Director until 2009. In 2009, he established the AEHS Foundation. He helped found Amherst Scientific Publishers and co-created seven peer-reviewed journals: *Journal of Soil and Sediment Contamination* (1990); *Human and Ecological Risk Assessment* (1994); *Journal of Phytoremediation* (1998); *Journal of Environmental Forensics* (1999); *Journal of Children's Health* (2003); *Non-Linearity Journal* (2003); and *Journal of Medical Risks* (2004). In addition, Dr. Kostecki co-created the International Society for Environmental Forensics in 2002.

From September, 2003 to August, 2009, Dr. Kostecki served as Vice Provost for Research and Vice Chancellor for Research and Engagement at the University of Massachusetts Amherst. He presently serves as Special Advisor for the Clean Energy China Initiative, Office of the President, University of Massachusetts.

Edward J. Calabrese is a board certified toxicologist and professor of toxicology at the University of Massachusetts School of Public Health at Amherst. Dr. Calabrese has researched extensively in the area of host factors affecting susceptibility to pollutants and has authored more than 300 papers in scholarly journals, as well as 24 books, including: *Principles of Animal Extrapolation; Nutrition and Environmental Health, Vols. 1 and 2; Ecogenetic: Safe Drinking Water Act: Amendments, Regulations, and Standards; Soils Contaminated by Petroleum: Environmental and Public Health Effects; Petroleum Contaminated Soils, Vols. 1, 2 and 3; Ozone Risk Communication and Management; Hydrocarbon Contaminated Soils, Vols. 1, 2, 3, 4 and 5; Hydrocarbon Contaminated Soils and Groundwater, Vols. 1, 2, 3, and 4; Multiple Chemical Interactions; Air Toxics and Risk Assessment; Alcohol Interactions with Drugs and Chemicals; Regulating Drinking Water Quality; Biological Effects of Low Level Exposures to Chemicals and Radiation; Contaminated Soils; Diesel Fuel Contamination; Risk Assessment and Environmental Fate Methodologies; Principles and Practices for Petroleum Contaminated Soils, Vols. 1, 2, 3, 4, and 5; Contaminated Soils, Vol. 1; and Performing Ecological Risk Assessments.* He has been a member of the U.S. National Academy of Sciences and NATO Countries Safe Drinking Water Committees, and the Board of Scientific Counselors for the Agency for Toxic Substances and Disease Registry (ATSDR). Dr. Calabrese also serves as Director of the Northeast Regional Environmental Public Health Center at the University of Massachusetts, Chairman of the BELLE Advisory Committee and Director of the International Hormesis Society.

James Dragun, Ph.D., is a soil chemist with extensive experience dealing with soil remediation. He has addressed the extent, danger, and/or cleanup of chemicals at sites of national and international concern such as the oil lakes caused by the 1991 Persian Gulf War (Kuwait), VX chemical warfare agent for the U.N. Weapons Inspection Program (Iraq), malfunction of the Three Mile Island Nuclear Power Plant (USA), and dioxin in Missouri (USA). Twenty-four nations including Japan, Canada, the United Kingdom, Australia, Germany, Switzerland, Italy, France, Spain, Scandinavia, and the Netherlands have utilized his expertise.

He founded and built an environmental engineering-science consulting company. For 18 years, he has led a team of specialists in chemical engineering,

civil engineering, environmental engineering, geotechnical engineering, mechanical engineering, physics, plant engineering, environmental science, geology, hydrogeology, chemistry, biochemistry, toxicology, and biology. Dr. Dragun and his associates have solved environmental issues for major companies and governments in six continents (Africa, Asia, Australia, Europe, North America, and South America).

Dr. Dragun is a full Professor at the University of Massachusetts and at Wayne State University, Detroit, MI. He has authored two college textbooks and co-authored/edited eight technical books. Also, Dr. Dragun has been the Editor-in-Chief of the International Journal of Soil and Sediment Contamination for over 15 years.

