

Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy

Volume 13

Article 1

January 2010

Contaminated Soils, Sediments and Water, Volume 13

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(2010) "Contaminated Soils, Sediments and Water, Volume 13," *Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy*: Vol. 13 , Article 1.

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CONTAMINATED SOILS, SEDIMENTS, AND WATER
Volume 13

**CONTAMINATED SOILS, SEDIMENTS, AND WATER
Volume 13**

**Analysis
Bioremediation
Brownfields
Chemical Oxidation
Environmental Fate
Environmental Forensics
Ethics in Environmental Practice
Heavy Metals
Modeling
Regulatory
Remediation
Risk Assessment
Sediments**

Edited by

Paul T. Kostecki
Edward Calabrese
James Dragun

ISBN-10: 0-9787640-2-1 ISBN-13: 978-0-9787640-2-1

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Annual International Conference on Soil, Sediments and Water
Environmental Health Sciences Department
School of Public Health and Health Sciences
N 344 Morrill Science Center
University of Massachusetts
Amherst, MA 01003 USA

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Foreword

For the biosphere to sustain human life ecosystem components must function collectively to provide the physical, chemical, and biological services on which we depend. Energy flux, matter cycling, temperature amelioration, gas exchange, water provision, and pH constraints are among the large-scale processes on which life depends. For these and the infinitely intricate web of interactions at lower levels of the biogeochemical hierarchy to continue, each ecosystem structure and function must operate within individual limits that allow the aggregated holistic enterprise to prosper.

In the middle decades of the past century, medical researcher Hans Selye postulated and documented a General Adaptation Syndrome of consistent physiological responses of organisms to diverse challenges. His original vision of G.A. Syndrome has needed some tweaking to accommodate subsequent findings regarding the importance of nonspecific inflammatory response and the pathogenic nature of gastrointestinal ulcers. But Selye's elucidation of changes in structures and functions of an organism fighting for homeostasis under threat provided a useful framework for understanding relationships between stress and health.

Stresses beyond the individual level in the ecosystem engender homeostatic resistance (for example, fecundity drops in some populations when trophic resources are limited) and potential for permanent alteration when pushed beyond response thresholds. By analogy, ecosystem "stresses" can be characterized diagnostically and treated when long-term consequences are anticipated.

The "good earth" of the ecosystem—soils and sediments—is the source of many of the biogeochemical responses to environmental stress, and a critically important component that, when "broken"—impaired at substantive levels—must be "repaired"—restored—for the system as a whole to function effectively. Stewardship of soils and sediments for sustainability requires that we diagnose impairments, reduce or eliminate impairments by remediation, and assist whole-system recovery by restoration. The papers gathered in this volume provide a rich source of resources for evaluating, remediating, and restoring stressed soils and sediments. The authors are practitioners at the cutting edge of the field of environmental management. Their contributions published here represent reports from the front lines on the state-of-the-science of analysis, assessment, management policy, remediation technology, and regulation. The compendium you hold in your hands is a source of information to help you keep up-to-date and a challenge to you to build out the next steps in soil and sediment assessment and management. We look forward to working with you to maintain and enhance the health of the biosphere for our children and their children.

David F. Ludwig, Scientist

ARCADIS

Contributing Authors

- Mohamed S. Abdel-Rahman**, UMDNJ, 2690 Ballard Ave., Orlando, FL 32833
- Halim Md. Abdul**, Kyushu University, Department of Urban and Environmental Engineering, Graduate School of Engineering, 6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan
- Razzak Abdur**, Kyushu University, Department of Urban and Environmental Engineering, Graduate School of Engineering, 6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan
- George R. Alther**, Biomin, Inc., PO Box 22028, Ferndale, MI 48220
- Joseph A. Amari**, Bechtel Savannah River Co.
- Norman Anderson**, American Lung Association of Maine, 122 State Street, Augusta, ME 04330
- Gianni Andreottola**, University of Trento, Department of Civil and Environmental Engineering, Via Mesiano 77, 38050 Trento (TN), Italy
- Violina R. Angelova**, Agricultural University, Dept. of Chemistry, Mendeleev street 12, Plovdiv, 4000, Bulgaria
- Blanca Antizar-Ladislao**, Universidad de Cantabria -Campus de Torrelavega, Dpto. de Ciencias y Técnicas del Agua y del Medio Ambiente, Bulevard Ronda Rufino Peón, 254 – Tanos, 39316 Torrelavega, Cantabria Spain
- Il-Sang Bae**, Seoul Metropolitan Govern Research Institute of Public, Health and Environment, 202-3 Yangjae-Dong Seocho-Gu, Seoul, 137-130Korea
- Michael Berger**, Simmons College, 300 The Fenway, Boston, MA 02115
- David A. Binstock**, RTI International, P.O. Box 12194, Research Triangle Park, NC 27709
- Robert Blundy**, Washington Savannah River Company, Savannah River Site, , , Aiken, SC 29808
- Richard C. Bost**, Environmental Resources Management, 15810 Park Ten Place, , , Houston, Texas 77084
- Lorenzo Reyes Bozo**, Pontificia Universidad Católica de Chile, Department of Chemical Engineering and Bioprocesses, Vic. Mackenna 4860, , , Macul, Santago Chile
- Dean Brammer**, Weston Solutions, Inc., 1 Wall Street, Manchester, NH 03101
- Rosemary Carroll**, Desert Research Institute, Division of Hydrologic Sciences, 2215 Raggio Parkway, Reno, NV 89512
- Liliana Cecan**, McLane Environmental, LLC, 707 Alexander Road, Suite 206, Princeton, NJ 08540
- E. Cervantes-González**, Escuela Nacional de Ciencias Biológicas, Depto. de Microbiología, Casco de Sto. Tomas, Mexico City, 11340 México
- Douglas J. Covert**, Hazardous Substance & Waste Management Research, 2976 Wellington Circle West, Tallahassee, FL 32309
- R. Cruz-Camarillo**, Escuela Nacional de Ciencias Biológicas, Depto. de Microbiología, Casco de Sto. Tomas, Mexico City, 11340México
- Ahmed H. A. Dabwan**, Mie Industry and Enterprise, Support Center, Shima, Ugata, Mie 517-0501, Japan
- Paul A. Eisenstat**, Bechtel Savannah River Co.

- Seok-Won Eom**, Seoul Metropolitan Government Research Institute of Public Health and Environment, 202-3 Yangjae-dong Sucho-Gu, Seoul 137-130, Korea
- Lonnie Fallin**, Jacobs Engineering, 6 Otis Park Drive, Bourne, MA 02532
- Mark E. Farrar**, Savannah River National Laboratory
- Elisa Ferrarese**, University of Trento, Department of Civil and Environmental Engineering, Via Mesiano 77, 38050 Trento (TN), Italy
- Bob Frye**, GEC Environmental Contracting Corp, 13880 Berlin Turnpike, Lovettsville, VA 20180
- Satya Ganti**, Sarva Bio Remed, LLC, 36 South Broad Street, Trenton, NJ 08608
- J. García-Mena**, Cinvestav- Unidad Zacatenco, Depto. de Genética y Biología Molecular, Av. IPN 2508, Mexico City, 07360 México
- Alex Godoy-Faúndez**, Universidad Andrés Bello, Ave Republica 200, , , , Santiago Centro, Santiago Chile
- William F. Gutknecht**, RTI International, P.O. Box 12194, Research Triangle Park, NC 27709
- Amy Hanna**, Case Western Reserve University, Department of Civil Engineering, Cleveland, OH 44106-7201
- Anna Marie M. Herb**, Savannah River National Laboratory
- Brad Horn**, Redux Technology, P.O. Box 331, Newfane, VT 05345
- Daizo Imai**, Mie Industry and Enterprise, Support Center, Shima, Ugata, Mie 517-0501, Japan
- Krasimir I. Ivanov**, Agricultural University, Dept. of Chemistry, Mendeleev street 12, Plovdiv, 4000, Bulgaria
- Aaron A. Jennings**, Case Western Reserve University, Department of Civil Engineering, Cleveland, OH 44106-7201
- Barry L. Johnson**, Assistant Surgeon General (ret.), 2618 Riverglenn Circle, Dunwoody, GA 30338
- Satoshi Kaneco**, Mie University, Department of Chemistry for Materials, Faculty of Engineering, Tsu, , Mie 514-8507, Japan
- Ludvík Kašpar**, DIAMO, s. p., o. z. TUU, 471 27 Straz pod Ralskem, Czech Republic
- Tadaya Kato**, Mie Industry and Enterprise, Support Center, Tsu, Mie 514-0056, Japan
- Hideyuki Katumata**, Mie University, Department of Chemistry for Materials, Faculty of Engineering, Tsu, Mie 514-8507, Japan
- Oda Keita**, Kyushu University, Department of Urban and Environmental Engineering, Graduate School of Engineering, 6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan
- Jinno Kenji**, Kyushu University, Department of Urban and Environmental Engineering, Graduate School of Engineering, 6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan
- Majeda Khraisheh**, University College London, Department of Civil and Environmental Engineering, Gower street, London WC1E 6BT, UK
- Terry P. Killeen**, Washington Savannah River Co.
- Donald N. Kirkland**, GZA GeoEnvironmental, Inc, 380 Harvey Road, Manchester, NH 03103
- Hidetoshi Kohashi**, Public Works Research Institute, 1-6 Minamihara, Tsukuba City, Ibaraki Prefecture 305-8516 Japan
- Robert Kondelin**, Environmental Alliance, Inc., 1812 Newport Gap Pike, Wilmington, DE 19808
- Srikant Kothur**, Hazardous Substance & Waste Management Research, 2976 Wellington Circle West, Tallahassee, FL 32309
- Stefan V. Krustev**, Agricultural University, Dept. of Chemistry, Mendeleev street 12, Plovdiv, 4000, Bulgaria
- Steven R. Lamb**, GZA GeoEnvironmental, Inc, 380 Harvey Road, Manchester, NH 03103
- Valerie Lane**, GeoTrans, Inc., One Monarch Drive, Suite 101, Littleton, MA 01460
- Jae-Seung Lee**, Seoul Metropolitan Govern Research Institute of Public, Health and Environment, 202-3 Yangjae-Dong Seocho-Gu, Seoul, 137-130 Korea

- Aiduan Li**, University College London, Department of Civil and Environmental Engineering, Gower Street, London WC1E 6BT, UK
- Annamarie MacMurray**, Savannah River National Laboratory, Aiken, SC 29808
- Steve Markesic**, Redox Technology, LLC, 1441 Branding Lane, Suite 100, Downers Grove, IL 60515
- Yugo Masuya**, Public Works Research Institute, 1-6 Minamihara, Tsukuba City, Ibaraki Prefecture 305-8516Japan
- Andrea C. McWilliams**, RTI International, P.O. Box 12194, Research Triangle Park, NC 27709
- Michael R. Morgenstern**, Bechtel Savannah River Co.
- Michael W. Morris**, Jacobs Engineering, 6 Otis Park Drive, Bourne, MA 02532
- Jiří Mužák**, DIAMO, s. p., o. z. TUU, Machova 201, 471 27 Straz pod Ralskem, Czech Republic
- César Sáez Navarrete**, Pontificia Universidad Católica de Chile, Department of Chemical Engineering and Bioprocesses, Vic. Mackenna 4860, Macul, Santago Chile
- Bette Nowack**, Weston Solutions, Inc., 1 Wall Street, Manchester, NH 03101
- Kiyohisa Ohta**, Mie University, Department of Chemistry for Materials, Faculty of Engineering, Tsu, Mie 514-8507, Japan
- Paul Ollila**, MassDEP, 627 Main Street, Worcester, MA 01608
- Robert G. Perry**, Environmental Resources Management, 15810 Park Ten Place, Houston, Texas 77084
- Bernd W. Rehm**, ReSolution Partners, LLC, P.O. Box 44181, Madison, WI 53744-4181
- Gary Richards**, Redux Technology, 1317 Pennsridge Court, Downingtown, PA 19335
- N.G. Rojas-Avelizapa**, Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada – IPN, Cerro Blanco 141, Col. Colinas del Cimatario, , Querétaro, Qro 76090México
- L.I. Rojas-Avelizapa**, Escuela Nacional de Ciencias Biológicas, Depto. de Microbiología, Casco de Sto. Tomas, Mexico City, 11340México
- I. Richard Schaffner, Jr.**, GZA GeoEnvironmental, Inc, 380 Harvey Road, Manchester, NH 03103
- Robert Schleicher**, Thermo Fisher Scientific, 900 Middlesex Turnpike, Building 8, Billerica, MA 01821
- Robert A. Schneiker**, Environmental Software Consultants, Inc., P.O. Box 2622, Madison, WI 53701-2622
- Henry J. Schuver**, U.S. EPA – OSW, Ariel Rios Bldg (MC-5303W), 1200 Pennsylvania Ave. NW, Washington, DC 20460
- Elizabeth A. Shaffer**, Malcolm Pirnie Inc, 1300 E 8th Ave, Tampa, FL 33607
- Gerald K. Sims**, USDA Agricultural Research Service, 1102 S. Goodwin Ave, Urbana, IL 61801
- Rajiv Kumar Singh**, Central Pollution Control Board, M/o Env't.& Forests; Govt.of Ind, PIC-UP Building (GF), Gomtinagar, Lucknow-10, Uttar Pradesh, India
- Gloria A. Skowronski**, UMDNJ, New Jersey Medical School, Pharmacology and Physiology Dept., 185 South Orange Avenue, Newark, NJ 07101
- James S. Smith**, Trillium, Inc., 8 Grace's Drive, Coatesville, PA 19320-1206
- Jim Soukup**, Weston Solutions, Inc., 1 Wall Street, Manchester, NH 03101
- Laura Stupi**, Thermo Fisher Scientific, 900 Middlesex Turnpike, Building 8, Billerica, MA 01821
- Tohru Suzuki**, Mie University, Environmental Preservation Center, Tsu, Mie 514-8507, Japan
- Isamu Takahashi**, Public Works Research Institute, 1-6 Minamihara, Tsukuba City, Ibaraki Prefecture 305-8516Japan
- Hitoshi Taninaka**, Public Works Research Institute, 1-6 Minamihara, Tsukuba City, Ibaraki Prefecture 305-8516Japan
- Christopher Teaf**, Florida State University, Center for Biomedical & Toxicological Research and Waste Management, 2035 East Dirac Drive, Suite 226 HMB, , Tallahassee, FL 32310-3700USA
- Janis Tsang**, USEPA, Region I, One Congress Street, Suite 1100, Boston, MA 02114
- Rita M. Turkall**, UMDNJ, Newark, NJ
- John J. Warwick**, Desert Research Institute, Division of Hydrologic Sciences, 2215 Raggio Parkway, Reno, NV 89512

Hiroshiro Yoshinari, Kyushu University, Department of Urban and Environmental Engineering,
Graduate School of Engineering, 6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan

Acknowledgments

We wish to thank all agencies, organizations and companies that sponsored the conference. Without their generosity and assistance, the conference and this book would not have been possible.

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About the Editors

Paul T. Kostecki, Vice Provost for Research Affairs, University of Massachusetts at Amherst and Associate Director, Northeast Regional Environmental Public Health Center, School of Public Health, University of Massachusetts at Amherst, received his Ph.D. from the School of Natural Resources at the University of Michigan in 1980. He has been involved with human and ecological risk assessment and risk management research for the last 13 years. Dr. Kostecki has co-authored and co-edited over 50 articles and 16 books on environmental assessment and cleanup including: Remedial Technologies for Leaking Underground Storage Tanks; Soils Contaminated by Petroleum Products; Petroleum Contaminated Soils, Vols. 1, 2, and 3; Hydrocarbon Contaminated Soils and Groundwater, Vols. 1, 2, 3 and 4; Hydrocarbon Contaminated Soils, Vols. 1, 2, 3, 4 and 5; Principles and Practices for Petroleum Contaminated Soils; Principles and Practices for Diesel Contaminated Soils, Vols. 1, 2, 3, 4 and 5; SESOIL in Environmental Fate and Risk modeling; Contaminated Soils, Vol. 1; and Risk Assessment and Environmental Fate Methodologies. Dr. Kostecki also serves as Associate Editor for the Journal of Soil Contamination, Chairman of the Scientific Advisory Board for Soil and Groundwater Cleanup Magazine, as well as an editorial board member for the journal Human and Ecological Risk Assessment.

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.