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## Education:

Georgia Institute of Technology, Atlanta, GA

Ph.D. Environmental Geochemistry, 1993
MS. Environmental Engineering, 1993
Georgia State University, Atlanta, GA
B.Sc. Geology, Cum Laude, 1988

**Research Interest**

My research focuses on the development and evaluation of innovative technologies for the cleanup of water, sediment, and soils. Particular emphasis is placed on sorption and degradation of contaminants and immobilization of metals. Specifically, my ongoing research focuses on the following five technologies:

**·** [Phytoremediation Technologies](http://www.gly.uga.edu/Nzengung/Phytoremediarion-GreenhouseTests.jpg): Cleanup of soils, sediment, water and air using green plants and root zone associated mechanisms.

**·** Microbial Mats Treatment System: Treatment of contaminated waters using green photosynthesizing microbial mats dominated by cyanobacteria.

**·** [Abiotic transformation of organic contaminants](http://dx.doi.org/10.1021/es001578b): Chemical treatment of contaminated soils and water. Emphasis is placed on the applications of activated bulk reductants in remediation of oxidized compounds, including the immobilization of metals.

**·** Preparation and characterization of surfactant modified (organo-modified clays or Clay nanocomposites) as cost-effective sorbents/filtration media for perchlorate and organic contaminants.

**·** [In-situ bioremediation of](http://www.gly.uga.edu/Nzengung/In-situTreatmentofPerchlorateContaminatedSoils.jpg) soils and groundwater: Biostimulation and enhancement of contaminants degradation in soil and groundwater using innovative techniques to deliver carbon and electron donors to the subsurface. This approach avoids expensive dig-and-treat of contaminated source area soils in the vadose zone.

**Phytoremediation Technologies**

Phytoremediation is the use of green plants (both aquatic and terrestrial) and the root zone associated microorganisms to cleanup hazardous waste sites. Phytoremediation involves a multitude of processes, thus the name phytoremediation technologies. A rigorous design of phytoremediation identifies and enhances the most applicable processes for the field site of interest. Phytoremediation is effective in treating livestock and poultry wastes, munitions constituents (e.g., perchlorates and nitroaromatics), organic contaminants, and metal contaminated hazardous waste sites. Compared to other remediation approaches, phytoremediation is more acceptable to the public and regulatory agencies because the ecosystem health is significantly improved during cleanup of the contaminants of concern. The trees also remove greenhouse gases from the atmosphere to produce biomass, which could be utilized as raw material for biofuels production.

My research group has screened many species of terrestrial and aquatic plants for the purpose of identifying the most effective species for phytoremediation of the different groups of contaminants. The data generated from our laboratory studies, so far, has been valuable in the development of better environmental fate models by regulatory agencies, design, and field application of phytoremediation technologies. We have coupled laboratory and field data from our analysis of plants used in a demonstration project at the Carswell Air Force base in Fort Worth, Texas, to provide a better understanding of phytoremediation processes and pathways for chlorinated organic solvents. Also, at a Naval Facility in Florida, we have successfully coupled phyto-processes and natural attenuation to accelerate the cleanup of a shallow chlorinated solvent plume upwelling into a wetland and recreational lake. Our research also involves engineered phytoremediation; an innovative approach for biostimulation and enhancement of rapid rhizodegradation of degradable contaminants such as nitrate, perchlorate, explosives constituents, chlorinated solvents, pesticides, and petrochemicals. Rhizodegradation enhancement significantly reduces the cleanup time and minimizes uptake and accumulation of degradable contaminants in plant tissues. Thus, if rhizodegradation can be successfully achieved, there is no need to dispose of the plant matter as hazardous waste when the soils and water cleanup goals have been achieved.

**Microbial Mats Treatment System**

Microbial mats are naturally occurring stratified microbial communities, composed of a complex consortia of bacteria dominated by photoautrophic cyanobacteria (also referred to blue-green algae). Mats generally include anoxygenic photoautrotrophs (purple bacteria) as well as sulfur-reducing microorganisms. They are tightly annealed together within a negatively charged polymeric matrix of gel. The 3.5 billion-year survival of mats testifies to their successful capacity in altering hostile environments through cellular and community-­mediated activities.

“Constructed” microbial mats grown using a standard technique that is very inexpensive and can be accomplished with minimal training is used at the bench and field scale to treat complex waste streams and produce biomass. The mats are very effective for sequestering or precipitating metals/radionuclides by surface absorption or by altering the surrounding chemical environment, thus they bioconcentrate the metals/radionuclides in a small volume (<5% of wet mass). The microbial mats are used to mineralize organic and inorganic contaminants, including pesticides, munitions constituents (i.e., perchlorate and explosive compounds), petrochemicals, and chlorinated solvents. Because microbial mats use greenhouse gases to produce biomass and are among the fastest growing photoautotrophs, they show great promise in the production of biomass for bioenergy. My research group continues to develop new applications for microbial mats in bioenergy, bioremediation, and sequestration of greenhouse gases.



[**In-situ Bioremediation of Contaminants in Soils and Groundwater**](http://www.gly.uga.edu/Nzengung/In-situTreatmentofPerchlorateContaminatedSoils.jpg)

Contaminated soils are often the long-term sources of contaminants leached into surface and ground waters. Most soils will normally contain natural bacteria capable of degrading the contaminants of concern. As a result, the persistence of degradable contaminants in soils and groundwater is commonly caused by the limited supply of nutrients and suitable environmental conditions to support the growth of microorganisms capable of degrading the contaminants of concern. Building on results of multiple bench scale tests, we have demonstrated at field sites the efficacy of in-situ bioremediation by applying suitable carbon and electron donors at the soil surface and progressively mobilizing into the groundwater below. The amendments mixed in with the surface soils create suitable conditions for growth of significantly high numbers of indigenous microorganisms capable of degrading the contaminants of concern. The successful infiltration of selected suitable carbon and electron donors through the vadose zone into the site groundwater apparently creates favorable environmental conditions for the growth of very high numbers of the microorganism capable of degrading the contaminants. Even more important, the latter approach achieves a larger foot print of bioremediation than injection systems. This Surface Application and Mobilization of Nutrient Amendments process has been successfully applied at the field scale to cleanup perchlorate, munitions, pesticides, and petrochemicals in vadose zone soils and groundwater. Since there is no dig-and-treat involved, the technology costs are an order of magnitude less than for competing technologies, such as windrow composting, soil vapor extraction system, soil washing, pump-and-treat, thermal treatment.

[**Abiotic Transformation of Organic Contaminants**](http://dx.doi.org/10.1021/es001578b) **and Sequestration of Metals**

My research group has been studying the application of oxidation-reduction reactions of iron and other redox sensitive metals in soils and sediments in remediation of contaminated soils, sediment and waters. Our research has focused on the role of ferric (Fe(III)) and ferrous (Fe(II) iron because Fe(III) is the fourth most abundant element in earth materials and the most important electron acceptor following the onset of anoxic conditions in groundwater, soils and sediment. Completed and ongoing research involves the enhanced degradation of oxidized organic contaminants (e.g., chlorinated aliphatics and aromatics, explosives, PCBs, DDT, etc.) using the free radicals generated during the decomposition of bulk reductants under suitable environmental conditions. Aquifer material and soils are chemically treated with bulk reductants (e.g., dithionite) to create reducing conditions. Specific interest is placed on the reaction kinetics, identification of degradation products and determination of mass balance. The advantages offered by this innovative approach are: (1) in-situ redox manipulation using dithionite enhances reductive dechlorination of chlorinated organics and immobilization of metals, (2) rapid degradation of explosive compounds in soils and groundwater at Military Ranges and other Defense facilities, (3) the system can be easily optimized and regenerated, (4) no toxic end-products are generated, and (5) remediation costs are less than those of most conventional abiotic and biotic techniques.

**Preparation and characterization of surfactant modified clays (clay nanocomposites)**

Building on my previous research on sorption and degradation of organic pollutants, we are developing unique formulations of surfactant modified clay (SMC) for sorption and treatment of waste water. The SMC (also called organo-modified clays or organoclays) are effective sorbents for filtration of nitrate, perchlorate, metals and organic contaminants from water. My research also involves studying the effects of organic cosolvents, solute properties and organoclay structure on the mechanism of sorption of hydrophobic organic chemicals and development of nonselective organoclays. Since the raw clays are widely available and cheap, SMC can be utilized commercially as low cost use-and-toss sorbents.

**Invited Book Chapters**

**·** Nzengung, V. A., Hans F. Stroo, Tony M. Lieberman. 2007. Emerging Technologies for Perchlorate Bioremediation. *Publisher:* Environmental Security and Technology Certification Program (ESTCP*)* 2007 (In Press).

**·** Nzengung, V. A. 2006. “Using Hydroponic Bioreactors to Assess Phytoremediation Potential of Perchlorate,” Phytoremediation: Methods and Reviews, Neil Willey Eds. (In Press)

**·** Nzengung, V. A., O’Niell, W., McCutcheon, S.C., and Wolfe, N.L. 2003. “Chapter 16: Sequestration and Transformation of Water Soluble Halogenated Organic Compounds Using Aquatic Plants, Algae, and Microbial Mats” Phytoremediation: Transformation and Control of Contaminants*,* Steven C. McCutcheon and Jerald L. Schnoor Eds. John Wiley & Sons, Hoboken, NJ. p.499-528.

**·** Nzengung, V. A., and McCutcheon, S.C. 2003. “Chapter 29: Phytoremediation of Perchlorate,” Phytoremediation: Transformation and Control of Contaminants, Steven C. McCutcheon and Jerald L. Schnoor Eds. John Wiley & Sons, Hoboken, NJ. p.863-885.

**·** Nzengung, V. A., Wang C. 2000. “Chapter 21: Influences on Phytoremediation of Perchlorate Contaminated Water,” American Chemical Society (ACS) Special Symposium Series: Perchlorate in the Environment, Editor: Urbansky. Kluwer Academic/Plenum Publishers, New York. p.219 - 229.

**Journal Publications**

**·** Dawit D. Yifru and Nzengung, V. A. 2006. Uptake of Perchlorate by Vegetation Growing at Field Sites in Arid and Subhumid Climates. *Remediation* Autumn 2007. p. 53-68.

**·** Dawit D. Yifru and Valentine A. Nzengung. “Uptake of N-Nitrosodimethylamine (NDMA) from Water by Phreatophytes in the Absence and Presence of Perchlorate as a Co-contaminant.” Environmental *Science & Technology*, Vol. 40, p.7374-7380.

**·** Dawit D. Yifru and Valentine A. Nzengung. “Use of Dissolved Organic Carbon to Enhance Rhizodegradation and Minimize Uptake of Perchlorate (ClO4-) (Submitted 2006).

**·** Dawit D. Yifru and Valentine A. Nzengung. “Use of Dissolved Organic Carbon to Biostimulate Rapid Rhizodegradation of Perchlorate in Soil (Submitted 2006)

**·** Nzengung, V.A., Penning, H., and O’Niell, W. “Mechanistic Changes During Phytoremediation of Perchlorate Under Different Root Zone Conditions,” *International Journal of Phytoremediation*: Vol. 6, No. 1, pp. 63-83. 2004.

**·** Nzengung, V. A. and Jeffers, P.M. ‘Sequestration, Phytoreduction, and Phytooxidation of Halogenated Organic Chemicals by Aquatic and Terrestrial Plants,” *International Journal of Phytoremediation*: Vol. 3, No. 1, pp. 13-40. 2001.

**·** Nzengung, V. A., Castillo, R.M., Gates, W.P., Mills, G.L. “Abiotic Transformation of Perchloroethylene in Homogeneous Dithionite Solution and In Suspensions of Dithionite-Treated Clay Minerals,” Environmental *Science & Technology*, Vol. 35, No. 11, p.2244-2251. 2001.

**·** Garrison, A. W., Nzengung, V. A., Avants, J. K., Ellington, J. J., Wolfe, N. Lee. “Phytodegradation of p,p’-DDT and Enantiomers of o,p’-DDT,” *Environmental Science & Technology*, Vol. 34, p.1663–1670. 2000.

**·** O’Niell, W., Nzengung, V. A., Noakes, J., Bender, J., Phillips, P. “Biosorption and Biodegradation of Tetrachloroethylene and Trichloroethylene Using Mixed-Species Microbial Mats,” *Journal of Hazardous Substance Research*. Vol. 2. 2000. p. 2-1 to 2-16. [**(PDF)**](http://www.engg.ksu.edu/HSRC/JHSR/vol2no2.pdf)

**·** Nzengung, V. A., Wang, C., Harvey, G. “Plant-Mediated Transformation of Perchlorate into Chloride,” *Environmental Science & Technology*, Vol. 33, p.1470-1478. 1999.

**·** Nzengung, V. A., Wolfe, L.N., Rennels, D., McCutcheon, S.C. “Use of Aquatic Plants and Algae for Decontamination of Waters Polluted with Chlorinated Alkanes,” *International Journal of Phytoremediation*, Vol. 1, No. 3, p.203-226. 1999.

**·** Jeffers, P.M., Wolfe, N.L., Nzengung, V. A. “Green Plants: A Terrestrial Sink for Atmospheric CH3Br,” *Geophysical Research Letters*, Vol. 25, No. 1, p.43-46. 1998.

**·** Nzengung, V. A., Nkedi-Kizza, P., Voudrias, E. A. “Organic Cosolvent Effects on Sorption Kinetics of Hydrophobic Organic Chemicals by Organoclays,” *Environmental Science & Technology*,Vol. 31, No. 5, p.1470-1475. 1997.

**·** Nzengung, V. A., Voudrias, E.A., Nkedi-Kizza, P., Wampler, J.M., Weaver, C.E. “Organic Cosolvent Effects on Sorption Equilibrium of Hydrophobic Organic Chemicals by Organoclays,” *Environmental Science & Technology*, Vol. 30, No. 1, p.89-96. 1996.

**·** Voudrias, E.A, Nzengung, V. A., and Li, C. “Removal of Light Nonaqueous Phase Liquids (LNAPLs) by Flushing,” *Journal of Waste Management*, Vol. 14, No.2, p.115-126. 1994.

**Other Publications**

**Conference Proceedings and Other Invited Papers**

**·** EPA 542-R-05-001. January 2005. www.rtdf.org: “Evaluation of Phytoremediation for Management of Chlorinated Solvents in Soil and Groundwater” prepared by the USEPA's Remediation Technologies Development Forum: Phytoremediation of Organics Action Team, Chlorinated Solvents Workgroup. Authored by USEPA Remediation Technologies Development Forum (RTDF): Phytoremediation of Chlorinated Solvents Subgroup Members.

**·** Nzengung, V.A and O'Niell, W. “In-Situ Bioremediation of Explosives and Perchlorate in Vadose Zone Source Areas” 2005 NGWA Conference on MTBE and Perchlorate: Assessment, Remediation, and Public Policy. May 26 – 27, 2005. Proceedings of the 2005 National Ground Water Association Press. Copyright 2005. ISBN #1-56034-120-3. p. 307-319 [**Learn More**](http://www.ngwa.org/gwol/in_situ_bioremediation_explosives_perchlorate_in_vadose.aspx)

**·** \*Dawit D. Yifru and Nzengung, V.A. “Enhancement of Microbial Degradation of Perchlorate (ClO4-) in the Rhizosphere,” *Paper A-23*, in: B.C. Alleman and M.E. Kelley (Conference Chairs), *In Situ and On-Site Bioremediation—2005*. Proceedings of the Eighth International In Situ and On-Site Bioremediation Symposium (Baltimore, Maryland; June 6–9, 2005). ISBN 1-57477-152-3, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore.

**·** \*Dawit D. Yifru and Nzengung, V.A. “Biostimulation and Enhancement of Rhizodegradation of Perchlorate during Phytoremediation,” 2005 NGWA Conference on MTBE and Perchlorate: Assessment, Remediation, and Public Policy. May 26 – 27, 2005. Proceedings of the 2005 National Ground Water Association Press. Copyright 2005. ISBN #1-56034-120-3. p. 249-258. [**Learn More**](http://www.ngwa.org/gwol/biostimulation_enhancement_rhizodegradation_perchlorate.aspx)

**·** \*Lina Wayo and Nzengung, V.A. “Biodegradation of Polycyclic Aromatic Hydrocarbons in Compost Extract Treated Soils,” *Paper F-27*, in: B.C. Alleman and M.E. Kelley (Conference Chairs), *In Situ and On-Site Bioremediation—2005*. Proceedings of the Eighth International In Situ and On-Site Bioremediation Symposium (Baltimore, Maryland; June 6–9, 2005). ISBN 1-57477-152-3, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore.

**·** \*O'Niell, W.L. and Nzengung, V.A. “In-Situ Bioremediation and Phytoremediation of Contaminated Soils and Water: Three Case Studies,” US Baltic International Symposium - Advances in Marine Environmental Research, Monitoring and Technologies, June 15-17, 2004, Klaipeda, Lithuania. 6p.

**·** Sparling, D.W., Harvey, G., and Nzengung, V.A. “Interaction Between Perchlorate and Iodine in the Metamorphosis of *Hyla versicolor*” Multiple Stressor Effects in Relation to Declining Amphibian Populations. ASTM STP 1443. *Editors*: G. Linder, S. Krest, E. Little, and D.W. Sparling, American Society for Testing and materials, West Conshohocken, PA, 2002.

**·** \*O'Niell, W. and Nzengung, V.A. “Feasibility of In Situ Bioremediation of Perchlorate Contaminated Soils,” *Paper C-09*, in: V.S. Magar and M.E. Kelley (Eds.), *In Situ and On-Site Bioremediation—2003.* Proceedings of the Seventh International In Situ and On-Site Bioremediation Symposium (Orlando, FL; June 2003). ISBN 1-57477-139-6, published by Battelle Press, Columbus, OH, [www.battelle.org/bookstore](http://www.battelle.org/bookstore).

**·** Spriggs T, Tsangaris S, Nzengung VA, Nwokike B. 2004. Phytoremediation of a chlorinated solvent plume in Orlando, Florida. *Paper F-13*, in: V.S. Magar and M.E. Kelley (Eds.), *In Situ and On-SiteBioremediation—2003.* Proceedings of the Seventh International In Situ and On-Site Bioremediation Symposium (Orlando, FL; June 2003). ISBN 1-57477-139-6, published by Battelle Press, Columbus, OH, [www.battelle.org/bookstore](http://www.battelle.org/bookstore).

**·** \*O'Niell, W. and Nzengung, V.A. “Field Demonstration of In-situ Bioremediation of Perchlorate-Contaminated Soils and Groundwater,” A&WMA 96th Annual Conference & Exhibition Proceedings. San Diego, CA. June 22 - 26, 2003. http://secure.awma.org/OnlineLibrary/ProductDetails.aspx?productID=2889

**·** \*Kastner, J.R., Das, K.C., Nzengung, V.A., Dowd, J., Fields, J. “In-situ Bioremediation of Perchlorate-Contaminated Soils,” *Editor*: Leeson et al. 6th International. In Situ and On-Site Bioremediation Symposium, San Diego, CA. p.289-295. 2001.

**·** \*Nzengung, V. A., Wang C. and Stacey B. “Phytotransformation Pathways and Mass Balances for Chlorinated Alkanes and Alkenes,” EPA’s Phytoremediation State of the Science Conference. Boston, MA. May 1-2, 2000. *EPA Technical Publication No.* EPA/625/R-01/011a November 2001.

**·** \*Nzengung, V. A., O’Niell, W., Adesida A. “Treatment of Perchlorate Contaminated Water in Microbial Mat, Algae, and Ebb-and-Flow Hydroponic Bioreactors,” Symposium Series: Case Studies in the Remediation of Chlorinated and Recalcitrant Compounds. Editors: Godage B. Wickramanayake, Arun R. Gavaskar, James T. Gibbs, and Jeffrey L. Means. Battelle Press, Columbus, OH. 2(7), p.101-106. 2000.

**·** \*O’Niell, W. and Nzengung, V. A. “Treatment of Organic Contaminated water in Microbial Mat Bioreactors,” Symposium Series: Bioremediation and Phytoremediation of Chlorinated and Recalcitrant Organics. Editors: Godage B. Wickramanayake, Arun R. Gavaskar, Bruce C. Alleman, and Victor S. Magar. Battelle Press, Columbus, OH. 2(4), p.347-252. 2000.

**·** Nzengung, V. A., Wang, C., Harvey, G., McCutcheon, S.C., and Wolfe, N.L. “Phytoremediation of Perchlorate Contaminated Water: Laboratory Studies,” Symposium Series: Fifth International Symposium on *In Situ* and *On-Site* Bioremediation: Phytoremediation. Editors; Leeson Andrea and B. C. Alleman. Battelle Press, p.239-244. 1999.

**·** Dhankher, O. P., Tucker, J., Nzengung, V. A., Wolfe, N.L. “Isolation, Purification and Partial Characterization of Plant Dehalogenase-Like Activity from Waterweed (Elodea Canadensis),” Symposium Series: Fifth International Symposium on *In Situ* and *On-Site* Bioremediation: Phytoremediation. Editors; Leeson Andrea and B. C. Alleman, Battelle Press, p.145-150. 1999.

**·** O’Niell, W.\*, Nzengung, V. A., Noakes, J., Bender, J. and Phillips, P. “Biodegradation of PCE and TCE Using Mixed-Species Microbial Mats” *Bioremediation and Phytoremediation*. Editors: G.B. Wickramanayake and Hinchee. Battelle Press, p.233 - 237. 1998.

**·** Arthur W. Garrison, Nzengung, V. A., Avants, J.K., Ellington, J., and Wolfe, N.L. “Determining the Environmental Enantioselectivity of o,p’-DDT and o,p’-DDD,” Proceedings of the 17th International Symposium on Chlorinated Dioxins and Related Compounds (Edited by Ronal Hites). Vol. 31, p.256 - 261. 1997.

**·** Nzengung, V. A., Voudrias, E.A., Wampler, J.M. “A Modified Clay as Adsorbent of an Organic Contaminant in Aqueous and Mixed-Solvent Systems” *Proceedings of the 48th Industrial Waste Conference, Purdue University, West Lafayette, Indiana,* Ed. Ronald F. Wukasch, Lewis Publishers, Chelsea, Michigan, p.387 - 391. 1993.

**·** Nkedi-Kizza, P. and Nzengung, V. A. “Use of the Cosolvency Model to Predict Sorption Kinetics and Equilibria of Diuron and Naphthalene on Organoclays,” *Kearney Foundation of Soil Science International Conference Proceedings, Vadose Zone Hydrology: Cutting Across Disciplines*. p.107 - 108. 1995.

**Reports**

**·** Mbuya, O.S. and Nzengung, V. A. 2006. Phytoremediation of Perchlorate and N-nitrosodimethylamine as single and co-contaminants. EPA Project Report # RD831090.

**·** Nzengung, V.A. 2002. “Phytoremediation of Perchlorate and Trichloroethylene Contaminated Water.” Grant/Contract # F6615-00-C-6060-2/10-21-RR176-261.

**·** Nzengung, V.A., Das, K.C. and Kastner, J.R. 2001. “Pilot-Scale In-Situ Bioremediation of Perchlorate-Contaminated Soils at the Longhorn Army Ammunition Plant in Karnack, Texas.” Contract # DAAA09-00-C-0060.

**·** Nzengung, V.A. 2001. “Phytoremediation of Perchlorate-Contaminated Soils and Water.” Agreement #: F33615-00-2-6001.

**·** Nzengung, V.A. 1999. “Data on Phytotransformation Process for the Degradation of Perchloroethene (PCE). Data Specific for the Orlando Naval Training Center (NTC), Orlando, Florida.” USEPA/NERL, Athens-GA and US Navy, Southern Division, Charleston-SC.

**·** Nzengung, V.A. 1999. “Phytodegradation Kinetics and Pathways of Perchlorate.” Presented to USEPA-NERL, Athens, GA.

**·** Nzengung, V.A. 1998. “Laboratory Characterization of Phytotransformation Products of PCE, TCE and Perchlorate.” For US Airforce, Wright Patterson AFB, Dayton, OH and USEPA-NERL, Athens, GA.

**·** Nzengung, V.A., Voudrias, E.A., Nkedi-Kizza, P., Wampler, J.M., Weaver, C.E. 1995. “Modified Clays as Sorbents for Aromatic Hydrocarbons in Aqueous and Mixed-Solvent Systems.” ERC 06-95, Georgia Water Resources Research Institute Program, Georgia Institute of Technology, Atlanta, Georgia, 52 p. (Technical Completion Report for USDI/Geological Survey Project 14-08-0001-G2013 (07)).

**·** Nzengung, V.A., Voudrias, E.A., Nkedi-Kizza, P., Wampler, J.M., Weaver, C.E. 1993. “Modified Clays as Sorbents for Aromatic Hydrocarbons in Aqueous and Mixed-Solvent Systems.” ERC 06-93, Georgia Water Resources Research Institute Program, Georgia Institute of Technology, Atlanta, Georgia, 56 p. (Technical Completion Report for USDI/Geological Survey Project 14-08-0001-G2013 (07)).

**International Meetings - Abstracts and Presentations**

**·** Nzengung, V.A. 2005. Phytoremediation of petrochemicals, perchlorate, and chlorinated solvents in soil and groundwater. International Conference on Energy, Environment and Disasters (INCEED 2005). Bridging the Gaps for Global Sustainable Development (UNESCO – ISEG – GADR). CHARLOTTE, NORTH CAROLINA, USA. July 24 - 30, 2005.

**·** Nzengung, V.A., Holger Penning. 2005. “Mechanisms of Phytoremediation of Co-contaminants: Perchlorate and Trichloroethylene (TCE).” Third International Phytoremediation Conference. April 20 – 22, 2005. Atlanta, Georgia. Hosted by USEPA.

**·** O'Niell, W.L. and V.A. Nzengung. 2003. “Feasibility of In Situ Bioremediation of Perchlorate Contaminated Soils.” In Situ and On-Site Bioremediation. The Seventh International Symposium, Orlando, Florida. June 2 – 5, 2003.

**·** Nzengung, V.A., Holger Penning, and Lina Wayo. 2003. “Effects of Experimental Conditions on Phytoremediation of Perchlorate.” In-Situ and On-Site Bioremediation. The Seventh International Symposium, Orlando, Florida. June 2 – 5, 2003.

**·** O'Niell, W.L. and V.A. Nzengung. 2002. “Remediation of Contaminated Water Using Microbial Mats.” 8th Annual Federation of European Chemists Conference on Chemistry and the Environment: Chemistry for a Sustaining World, Athens, Greece, Aug. 31-Sept. 4, 2002. *Environmental Science and Pollution Research-International*, Vol. 9, Special Issue No. 3, p.70.

**·** Nzengung, V. A., Das, K.C., Kastner, J., Browber, A.G. 2001. “Laboratory and Field Demonstration of In-Situ Bioremediation of Perchlorate-Contaminated Soil.” The 17th Annual International Conference on Contaminated Soils, Sediment and Water. University of Massachusetts Amherst. October 22-25, 2001.

**·** Nzengung, V. A., Kastner, J., Das, K.C. 2001. “Pilot Scale In-Situ Bioremediation of Perchlorate-Contaminated Soil.” In-Situ and On-Site Bioremediation. The Sixth International Symposium, San Diego, California. June 4 – 7, 2001.

**·** Nzengung, V. A., Anna Dondero and O’Niell, W. 2001. “Phytodegradation and Rhizodegradation of Trichloroethylene and Perchlorate.” In-Situ and On-Site Bioremediation. The Sixth International Symposium, San Diego, California. June 4 – 7, 2001.

**·** Nzengung, V. A., O’Niell, W., Adesida, A. 2000. “Treatment of Perchlorate Contaminated Water in Microbial Mat, Algae, and Ebb-and-Flow Hydroponic Bioreactors.” Symposium Series. 2nd International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey, California, May 22-25, 2000.

**·** Nzengung, V. A., Wolfe, N. L., Datta, N., Rennels, D. 1998. “Uptake and Transformation of Organic Compounds by Aquatic Plants.” First International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey, California, May 18 - 21, 1998.

**·** Nkedi-Kizza P., Nzengung, V. A. 1995. “Use of the Cosolvency Model to Predict Sorption Kinetics and Equilibria of Diuron and Naphthalene on Organoclays.” Kearney Foundation of Soil Science International Conference,University of California - Davis, CA.

**National Meetings - Abstracts and Presentations**

**·** Nzengung, V.A. Phytoremediation Mechanisms for different Types of Groundwater Contaminants. Biochemical Engineering Program University of Georgia Mini-Conference September 9, 2005

**·** Nzengung, V.A. and Mary Elizabeth Purvis. “Low-Cost Sustainable Treatment of Perchlorate-Contaminated Freshwater and Brines Using Surfactant Modified Clays.” 6th Environmental Technology Symposium and Workshop. Sustaining the Environment through Technology. March 14 – 16, 2005. Portland, Oregon.

**·** O’Niell, W.L. and Nzengung V.A. “In-Situ Bioremediation of Perchlorate-Contaminated Soils and Groundwater.” The Fifteenth Annual AEHS Meeting and West Coast Conference on Soils, Sediment, March 2005.

**·** Nzengung V.A. and Walter O’Niell. “In-Situ Bioremediation of Explosives and Perchlorate in Vadose Zone Soils and Groundwater.” SERDP/ESTCP Annual Symposium. Washington DC. November 29 - December 2, 2004.

**·** Harvey, G.J., O’Lear, J., Godfrey, R., Nzengung V. “Perchlorate in Marine Biota and By-products.” SERDP/ESTCP Annual Symposium. Washington, DC. December 2-4, 2003.

**·** Nzengung, V. A., Mills, G. L. and Heath, B. “Abiotic Transformation of Perchloroethylene (PCE) Using Dithionite Treated Clay Minerals, Iron Oxides and Silica.” 54th Southeast Regional meeting of the American Chemical Society (SERMACS). Charleston, South Carolina. November 13-16, 2002.

**·** Dumont, J.N., BurkhartJ., Nzengung, V.A. “The Effects of Ammonium Perchlorate on Reproduction of *Xenopus* Females.” SETAC 23nd Annual Meeting. Baltimore, Maryland. November 11-5, 2002.

**·** Nzengung, V.A., Das, K.C., Kastner, J., and Browder, G.A. “Pilot Scale In-Situ Bioremediation of Perchlorate Contaminated Soils at the Longhorn Army Ammunition Plant in Karnack, Texas.” SETAC 22nd Annual Meeting. Baltimore, Maryland. November 11-15, 2001.

**·** Nzengung, V. A., Anna Dondero. “The Role of Green Plants in the Removal of Perchlorate from Hydroponics and Organic-Rich Soils Systems.” SETAC 22nd Annual Meeting. Baltimore, Maryland. November 11-15, 2001.

**·** Nzengung, V. A., Kastner, J., Das, K.C. “Pilot Scale In-Situ Bioremediation of Perchlorate-Contaminated Soils.” The 6th Annual Pollution Prevention and Hazardous Waste Management Conference. San Antonio, Texas. August 20-23, 2001.

**·** Nzengung, V. A., and Ramaley, S. “Coupling Natural Attenuation and Phytoremediation to Cleanup a Shallow Chlorinated Solvent Plume at the Former Naval Training Center in Orlando, Florida.” 2001 International Containment & Remediation Technology Conference and Exhibition. Orlando, Florida. June 10-13, 2001.

**·** Nzengung, V. A., Heath, B. and Mills, G. L. “Relative Effectiveness of Chemically Reduced Clay Minerals and Iron Oxides in Remediation of Groundwater Contaminated with Perchloroethene.” 37th Annual Meeting of The Clay Minerals Society, Loyola University, Chicago, Illinois. June 24-29, 2000.

**·** Nzengung, V. A., and Payne, D. “Transformation of Chlorinated Organic Contaminants at the Surfaces of Dithionite-Treated Glass Beads, Sands and Aquifer Materials.” 37th Annual Meeting of The Clay Minerals Society, Loyola University, Chicago, Illinois. June 24-29, 2000.

**·** Nzengung, V. A. and O’Niell, W. “Marine Algae, Microbial Mats and Plant-Mediated Transformation of Organic Pollutants.” DOE/BI-OMP 2000. Florida A&M University, Tallahassee, Florida. March 15-16, 2000.

**·** Nzengung, V. A., C. Wang. “Influences on Phytoremediation of Perchlorate Contaminated Water.” 218th ACS National Meeting. Special Symposium Series: Perchlorate in the Environment. New Orleans, Louisiana. August 1999.

**·** Nzengung, V. A., Mills, G. L., Heath, B. “Transformation of Trichloroethylene (TCE) and Perchloroethylene (PCE) at the Surface of Dithionite Reduced Clay Minerals and Iron Oxides.” 217th American Chemical Society National Meeting, Anaheim, California. March 21 - 25, 1999.

**·** Nzengung, V. A., Mills, G. L., Heath, B. “Transformation of Trichloroethylene (TCE) and Perchloroethylene (PCE) at the Surface of Dithionite Reduced Clay Minerals and Iron Oxides.” Southeastern Geological Society of America Annual Meeting. Athens, Georgia. March 25 - 27, 1999.

**·** Nzengung, V. A. and Oates, M. T. “Sorption of Chlorobenzenes to Single- and Dual-Cation Organo-Modified Montmorillonites.” 35th Annual Meeting of the Clay Minerals Society. Cleveland, Ohio. June 6 - 10, 1998.

**·** Nzengung, V. A., Wolfe, N. L., Carreira, L. H., McCutcheon, S. C. “Aquatic Plants-Mediated Transformation of Halogenated Organics.” Gordon Research Conferences, Environmental Sciences: Water. New Hampton, New Hampshire. 1996.

**·** Nzengung, V. A., Wolfe, N. L., Carreira, L. H., McCutcheon, S. C. “Uptake and Transformation of Halogenated Organic Contaminants by Aquatic Plants,” Emerging Technologies in Hazardous Waste Management VIII: 1996 Book of Abstracts for the Special Symposium, Birmingham, AL, American Chemical Society (D.W. Tedder, Editor), p 36.

**·** Nzengung, V. A., Voudrias, E. A., Nkedi-Kizza, P. “Changes in Shape of Isotherms of Neutral Organics Measured in Mixed-Solvent Organoclay System.” 33rd Annual Meeting of the Clay Minerals Society. Gatlinburg, Tennessee. 1996.

**·** Nzengung, V. A., Nkedi-Kizza, P. “Organic Cosolvent Effects on Sorption Kinetics of Hydrophobic Organic Chemicals by Organoclays.” 87th Annual Meeting of ASA, CSSA and SSSA*,* St. Louis, Missouri. October 29 - Nov. 3, 1995.

**·** Nzengung, V. A., Voudrias, E. A., Nkedi-Kizza, P., Wampler, J.M. “Organic Cosolvent Effects on Sorption of Hydrophobic Organic Chemicals by Organoclays.” Gordon Research Conferences, Environmental Sciences: Water. New Hampton, New Hampshire. 1994.

**·** Nzengung, V. A., Voudrias, E. A., Nkedi-Kizza, P., Wampler, J. M., Weaver, C.E. “Modified Clays for the Adsorption of Aromatic Hydrocarbons from Aqueous and Mixed-Solvent Systems.” Industrial Pollution Control Conference, Georgia Water Pollution Control Association. Atlanta, Georgia. February 20 - 23, 1993.

**·** Nzengung, V. A., Voudrias, E. A., Nkedi-Kizza, P., Wampler, J. M. “Organic Cosolvent Effects on Sorption of Organic Pollutants by Four Alkylammonium Exchanged Clays.” Emerging Technologies in Hazardous Waste Management V: 1993. Book of Abstracts for the Special Symposium, Atlanta, GA, Industrial and Engineering Chemistry Division, American Chemical Society (D. W. Tedder, Editor) American Chemical Society, Washington, DC, 1080p. 1993.

**Invited Presentations of Research Papers**

**·** Nzengung, V. A. 2005. Advances in Rhizodegradation of Perchlorate during Phytoremediation. Strategic Environmental Research and Development Program (SERDP) conference, Washington DC. November-December, 2005.

**·** Walter O’Niell and Nzengung, V. A. Phytoremediation of Perchlorate: Research Presented to Scholars Committee on Perchlorate Review at the Urban Water Research Center at the University of California, Irvine, California. November 18 – 19, 2003.

**·** Nzengung, V. A., Wang, C. and Stacey Box. “Phytotransformation Pathways and Mass Balances for Chlorinated Alkanes and Alkenes.” EPA’s Phytoremediation State of the Science Conference. Boston, Massachusetts. May 1-2, 2000

**·** Nzengung, V. A., Heath, B., Mills, G. “Enhanced Degradation of Perchloroethylene (PCE) and Trichloroethylene (TCE) at the Surfaces of Dithionite-Treated Clay Minerals and Aquifer Materials.” USEPA-NERL, Athens, Georgia. March 18, 1999

**·** Nzengung, V. A. “How Clean Is Clean In Hazardous Waste Sites Remediation?” Perimeter Adult Learning and Services (PALS), Dunwoody, Georgia. June 1, 1999.

**·** Nzengung, V. A. “Do Plants Have a Role In the Clean-up of Contaminated Waste Sites?” 20 Master Gardener Volunteers. Conyers, Georgia. August 10, 1998

**·** Nzengung, V. A. “Phytoremediation of Perchlorate Contaminated Water.” Briefing to Perchlorate Working Group at Wright Patterson Air Force Base, Dayton, Ohio. August 19, 1998.

**·** Nzengung, V. A. “Phytoremediation of Perchlorate Contaminated Water.” Briefing to Perchlorate Working Group at Brooks Air Force Base, San Antonio, Texas. December 16 -17, 1998.

**·** Nzengung, V. A., C. Wang, Harvey, G., McCutcheon, S.C., and Wolfe, N. L. “Phytoremediation of Perchlorate Contaminated Water.” 4th Annual Strategic Environmental Research and Development Program (SERDP) Symposium, Washington, DC. December 1 - 3, 1998.

**·** Harvey, G.J., Eberts, S., Vose, J., Nzengung, V. A., Lee, R., Jones, S. “Phytoremediation of TCE in an Alluvial Aquifer: A Field Demonstration.” 4th Annual Strategic Environmental Research and Development Program (SERDP) Symposium, Washington DC. December 1 - 3, 1998.

**·** Nzengung V. A., Gates, W., Mills, G., Reyna, C. “Enhanced Degradation of Tetrachloroethylene by Redox-Manipulated Iron-Bearing Clays and Aquifer Material.” 3rd Annual Strategic Environmental Research and Development Program (SERDP) Symposium, Washington DC. December 3 - 5, 1997.

**·** Nzengung, V. A., McCutcheon, S.C., Wolfe, N. L. “Remediation of a Shallow Groundwater Plume of PCE. TCE, DCE and VC at the Orlando Naval Training College, Orlando, FL.” Annual USGS/DOD Environmental Conservation Hydrology Meeting in Charleston, South Carolina. 1997.

**·** Garrison, A. W, Nzengung, V.A., Avants, J. K., Ellington, J. J., and Wolfe, N. L. “Determining the Environmental Enantioselectivity of o,p’-DDT and Other Pesticides.” Environmental and Analytical Chemistry of Chiral Pollutants. Invited by Dr. Renee L. Falconer. SETAC 1997.

**·** Nzengung, V. A., Wolfe, N. L., and Carreira, L. H. “Plant-Enzyme Dechlorination of Chlorinated Organic Compounds.” EPA Symposium on Bioremediation of Hazardous Wastes: Research, Development, and Field Evaluations, The Rye Town Hilton, Rye Brook, New York. August 8 - 10, 1995.

**Graduate Students' Abstracts and Presentations**

**·** Schroer, Katherine L., R.C. Thomas, D.M. Endale, J.W. Washington, V. Nzengung (2006). Use of tracer injection experiments to quantify nitrate loss in two adjacent wetland streams draining an agricultural field in the Georgia Piedmont. Proceedings of the 2006 USDA/CSREES National Water Conference, San Antonio, TX. [http://www.extension.iastate.edu/WaterConf2006/](http://www.extension.iastate.edu/WaterConf2006/ShowAbstract.aspx?TypeID=2&PresID=214)

**·** Yifru, Dawit D., Nzengung, Valentine, 2005. Use of dissolved organic carbon to reduce plant perchlorate uptake during phytoremediation. Submitted to the 23rd American Chemical Society meeting (Geochemistry division), Washington DC. August-September, 2005.

**·** Yifru, Dawit D., Nzengung, Valentine, 2005. Removal of N-Nitrosodimethylamine from waters using sorption and phytoremediation approaches. Submitted to the Strategic Environmental Research and Development Program (SERDP) conference, Washington DC. November-December, 2005.

**·** Yifru, Dawit D., Nzengung, Valentine, 2005. Biostimulation and enhancement of rapid rhizodegradation of perchlorate. Submitted to the Strategic Environmental Research and Development Program (SERDP) conference, Washington DC. November-December, 2005.

**·** Schroer, Katherine and Valentine A. Nzengung. 2005. Distribution of N and other redox-sensitive species in two adjacent wetland streams draining an agricultural field in the Georgia Piedmont. 2005 Geological Society of America Annual Conference. Salt Lake City, Utah.

**·** Lina Wayo and Valentine A. Nzengung. 2005. Bioremediation of heavy end petrochemicals with compost amendments. International Conference on Energy, Environment and Disasters (INCEED 2005). Bridging the Gaps for Global Sustainable Development (UNESCO – ISEG – GADR). Charlotte, NC, USA. July 24 - 30, 2005.

**·** Dawit D. Yifru and Valentine A. Nzengung. 2005. Use of dissolved organic carbon to minimize plant uptake of perchlorate. 230th ACS National Meeting in Washington, DC, Aug 28-Sept 1, 2005.

**·** Dawit D. Yifru and Valentine A. Nzengung. 2005. “Enhancement of Microbial Degradation of Perchlorate (ClO4-) in the Rhizosphere.” In-Situ and On Site International Bioremediation. The Eighth International Symposium. Baltimore, Maryland. June 6 – 9, 2005.

**·** Dawit D. Yifru and Valentine A. Nzengung. 2005. “Biostimulation and Enhancement of Rhizodegradation of Perchlorate During Phytoremediation.” 2005 NGWA Conference on MTBE and Perchlorate: Assessment, Remediation, and Public Policy. May 26 – 27, 2005.

**·** Lina Wayo and Valentine A. Nzengung. 2005. “Biodegradation of Polycyclic Aromatic Hydrocarbons in Compost Extract Treated Soils.” In-Situ and On Site International Bioremediation. The Eighth International Symposium. Baltimore, Maryland. June 6 – 9, 2005.

**·** Dawit D. Yifru and Valentine A. Nzengung. 2005. “Biostimulation and Enhancement of Rhizodegradation During Phytoremediation of Perchlorate.” Third International Phytoremediation Conference. Atlanta, Georgia. April 20 – 23, 2005

**·** Dawit D. Yifru and Valentine A. Nzengung. 2004. “Biostimulation of Rhizodegradation of Perchlorate (ClO4-).” Geological Society of America. Denver, Colorado. November 2004.

**·** Uddin, M.M.K., G.L. Mills, J.C. Seaman, V.A. Nzengung. 2001. “Laboratory Studies of In-situ Redox Manipulation for Remediation of PCE, TCE and Cr (VI) Contaminated Groundwater in Atlantic Coastal Plain Sediments.” *In:* M.L. Trehy (Ed.), Preprints of paper presented at the 221st ACS National Meeting, April 1-5, 2001, San Diego, CA: American Chemical Society: Washington, DC, 2001; vol. 41(1), p.301-306.

**·** O’Niell, W. and Nzengung, V. A. “Treatment of Organic Contaminated Water in Microbial Mat Bioreactors.” Symposium Series. 2nd International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey, California. May 22-25, 2000.

**·** Payne, D. and Nzengung, V.A. 1999. “Chemically Induced Remediation of Sediments Contaminated with Chlorinated Aliphatics.” 217th American Chemical Society National Meeting, Anaheim, California. March 21 - 25, 1999.

**·** O’Niell, W., Nzengung, V.A., Noakes, J., Bender, J., Phillips, P. 1999. “Sorption and Transformation of Tetrachloroethylene and Trichloroethylene Using Mixed Species Microbial Mats.” Southeastern Geological Society of America Annual Meeting. Athens, Georgia. March 25 - 27, 1999.

**·** Heath, B., Nzengung, V.A., Mills, G. 1998. “Transformation of Perchloroethylene at the Surface of Dithionite-Reduced Clay Minerals and Iron Oxides.” 35th Annual Meeting of the Clay Minerals Society. Cleveland, Ohio. June 6 - 10, 1998.

**·** O’Niell, W., Nzengung, V.A., Noakes, J., Bender, J., Phillips, P. 1998. “Biodegradation of PCE and TCE Using Mixed-Species Microbial Mats.” First International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey, California. May 18 - 21, 1998.

**·** O’Niell, W., Nzengung, V.A., Noakes, J., Bender, J., Phillips, P. 1997. “Bioremediation of PCE and TCE Using Mixed-Species Microbial Mats.” In Emerging Technologies in Hazardous Waste Management VIII Special Symposium, Pittsburgh, PA, American Chemical Society (D.W. Tedder, Editor)*.*

**·** Castillo, R., Nzengung, V.A., Gates, W., Mills, G. 1997. “Enhanced Degradation of Tetrachloroethylene by Redox-Manipulated Iron-Bearing Clays and Aquifer Material.” 213th American Chemical Society National Meeting. San Francisco, California. April 13-17, 1997. Vol. 37, No. 1, p.180.

**Research Facilities**

Gas Chromatograph (Schimadzu) -- with electron capture and flame ionization detectors and autosampler.

Gas Chromatograph (Hewlett Packard) -- with flame ionization and thermal conductivity detectors and autosampler.

Gas Chromatograph (Hewlett Packard) -- with flame ionization and electron capture detectors and autosampler.

Capillary Gas Chromatograph - Mass Spectrometer (Schimadzu) -- computer controlled with automatic sampler and automated
data acquisition.

Ion Chromatograph (DX-100) with UV and conductivity detectors -- computer controlled with autosampler and data acquisition.

High Performance Liquid Chromatograph (DX -500) with UV and conductivity detectors - computer controlled with autosampler and data acquisition.

Liquid Scintillation Counter (Beckman LS 5800LL Series) -- Windows for 14C-isotope and tritium analysis

Reactors for laboratory characterization of phytoremediation of volatile organics

Hydroponic plant growth chambers with traps for capture of volatilized metabolites.

Anaerobic Liquid Exchanger

Geenhouse

**Teaching Experience**

Aqueous Environmental Geochemistry

Coastal Processes and Conservation

Earth Processes and Environments

Environmental Geosciences

Environmental Instrumental Analysis

Hazardous Waste Site Remediation

Organic Contaminant Hydrogeology

Water Resources Issues

**Other Interests**

[Georgia Water Resources](http://www.uga.edu/water)

Faculty of Engineering

African Studies Institute