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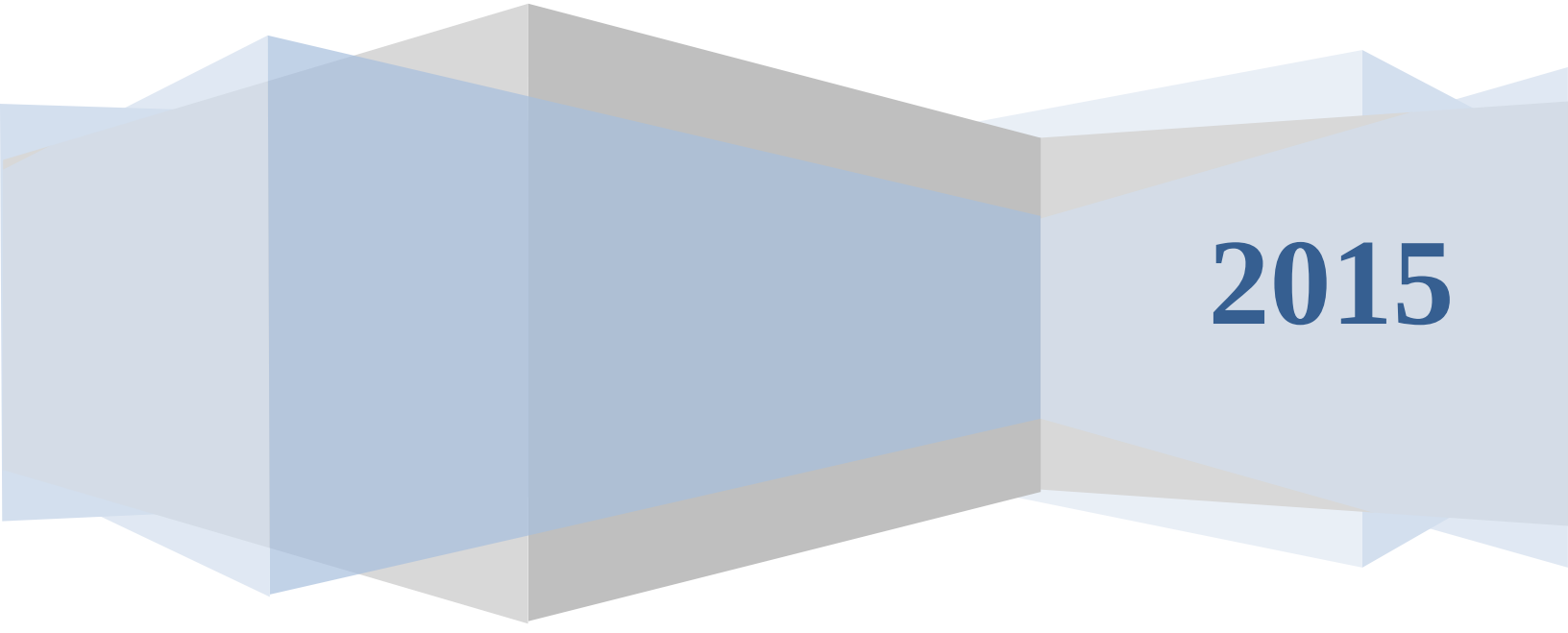
Final Report DE-EM0000594 –
Conference Paper/Proceeding



Subproject Title#1: Detection of *Sphingomonas* Strains for use in Polycyclic Aromatic Hydrocarbon Degradation

Principal Investigator: Dr. Waltena Simpson

Name of Conference	Location of Conference	Date of Conference	Conference Sponsor
United States Department of Energy Grantee Conference	Benedict College Columbia, SC	November 21, 2011	The Triangle Association of College
The Oil Sands and Heavy Oil Technologies Conference	Calgary, Alberta, Canada.	2012	
DOE-EM/HBCU Conference	South Carolina State University (SCSU)	April 11, 2012	South Carolina State University
SRNL-PARTNERING	SRNL Aiken, SC	January 31, 2013	SRNL-DOE
Partnering for Synergy and Success 2014 Research Collaboration Workshop and Poster Session	SRNL Aiken, SC	April 24, 2014	SRNL-DOE
American Society for Microbiology General	Boston, MA.	2014	American Society for Microbiology
Battelle Third International Symposium on Bioremediation and Sustainable Environmental Technologies	Miami, Florida	May 2015	Battelle Third International Symposium

United States Department of Energy Grantee Conference
Location: Benedict College, Columbia SC
Date: November 21, 2011

The Oil Sands and Heavy Oil Technologies Conference

Location: Calgary, Alberta, Canada
Date: 2012
Sponsor: The Oil Sands and Heavy Oil Technologies Conference

Biologically Enhanced Steeling of Dissolved Solids in Oil Sands Tailings (Poster)
R. L. Brigmon, C. Berry, R. Martinuzzi, V. Kostenko, A. Wade, W. Simpson and K. Stephenson

ABSTRACT
BioTiger™ is a unique natural patented microbial consortium that can enzymatically metabolize aliphatic and aromatic hydrocarbons, actively produce novel surfactants, and tolerant of wide ranging environmental conditions including temperature and pH extremes. Originally developed and used by the U.S. Department of Energy for bioremediation of oil-contaminated soils, recent efforts at both the University of Calgary and the Savannah River Laboratory have demonstrated that BioTiger™ can also be used to react with oil sands tailings, resulting in lower suspended solids. Both the BioTiger™ consortia as well as individual BioTiger™ strains were tested with oil sands tailings (3% bitumen) from Ft. McMurray, Canada. Controls included oil sands tailings tests with no bacteria added, inactivated BioTiger™, as well as other bacteria strains Escherichia coli and Pseudomonas aeruginosa. Testing at the University of Calgary showed a notable reduction in optical density in mixed oil sand tailing samples treated with select strains of BioTiger™ as compared to controls. Results of testing the same oil sands tailings at SRNL showed a two-fold reduction in suspended solids within 24 hours as measured by absorbance after treatment with the BioTiger™ consortia with no external carbon source added. It was also observed that the BioTiger™ treated oil sands tailings showed greater separation or a hydrocarbon ring at the top of the test tubes as compared to control tubes. Since BioTiger™ performs well at high temperatures process engineering can be used to enhance and sustain metabolic activity. The enzymatic and surfactant activity could also be applied to enhance recovery of hydrocarbons from oil sands tailings. These results indicate that BioTiger™ could be applied for reduction of suspended solids and potential formation of trafficable deposits.

Department of Energy HBCU Consortium Meeting

Location: Orangeburg, SC
Date: April, 2012
Sponsors: DOE and SCSU

Bioremediation of Polyaromatic Hydrocarbons: Technical Challenges
A. Wade, K. Atkins, W. Simpson and R.L. Brigmon

ABSTRACT
Oil spills are incidents that occur in the marine waters, like oceans, in the world. Because remediating oil spills can be extremely costly, a less expensive mechanism for removing oil from ocean water has been sought. One such mechanism is called BioTiger™. BioTiger™ is a combination of 12 microorganisms which are capable of degrading hydrocarbons. We examined the ability BioTiger™ to grow with different grades of oil such as crude oil and low grade Bitumen containing Canadian oil sands. Our results indicated that BioTiger™ exhibited the best growth in low grade Bitumen as opposed to crude oil. In the low grade Bitumen samples, dilutions were performed due to the loss of the aqueous layer needed in order to measure turbidity. While BioTiger™ did not show significant growth in crude oil, protein concentration analysis showed an increase in bacterial protein concentration at 24 hrs.

Department of Energy HBCU Consortium Meeting

Location: Aiken, SC
Date: April, 2014
Sponsor: DOE and SRNL

Bioprocessing-Based Approach for Bitumen/Water/Fines Separation and Hydrocarbon Recovery from Oil Sands and Tailings. (Poster)
R. L. Brigmon, C. J. Berry, K. Stephenson, C. Milliken, V. Kostenko, R. Martinuzzi, A. Wade**,** and W. Simpson.

ABSTRACT
Oil sands are a major source of oil but tailings ponds generated by the industrial processing are an environmental problem. The main concerns are mature fine tailings (MFT) composed of residual hydrocarbons, water and fine clay. In batch tests, BioTiger™, a microbial consortium that can metabolize PAHs, demonstrated improved oil sands tailings settling, resulting in lower suspended solids, turbidity, and lower total organic carbon in overlaying water. Recent environmental concerns have included the amount of water used in the process, energy cost to operate the systems, runoff from the tailings ponds, wastewater from the facilities, as well as chemical residues (e.g. paraffin's) in the water left over from the extraction process. This research project was developed to test bio augmentation or addition of natural microorganisms as a means of improving oils sands processing including separation of hydrocarbons form particles as well as improved settling of tailings. In this work we tested BioTiger™, a patented consortium of natural bacteria tested & isolated from a remediation project at a Polish Oil Refinery, with Canadian oil sands and tailings. Results demonstrated bio augmentation of BioTiger™ to oil sands and tailings respectively increased separation of organic carbon from particles in oil sands and enhanced settling with tailings with improved water quality.

American Society for Microbiology General Meeting

Location: Boston, Massachusetts.
Date: May, 2014
Sponsor: American Society for Microbiology

Bioprocessing-Based Approach for Bitumen/Water/Fines Separation and Hydrocarbon Recovery from Oil Sands and Tailings. (Poster)
R. L. Brigmon, C. J. Berry, K. Stephenson, C. Milliken, V. Kostenko, R. Martinuzzi, A. Wade**,** and W. Simpson.

ABSTRACT
Oil sands are a major source of oil but tailings ponds generated by the industrial processing are an environmental problem. The main concerns are mature fine tailings (MFT) composed of residual hydrocarbons, water and fine clay. In batch tests, BioTiger™, a microbial consortium that can metabolize PAHs, demonstrated improved oil sands tailings settling, resulting in lower suspended solids, turbidity, and lower total organic carbon in overlaying water. Recent environmental concerns have included the amount of water used in the process, energy cost to operate the systems, runoff from the tailings ponds, wastewater from the facilities, as well as chemical residues (e.g. paraffin's) in the water left over from the extraction process. This research project was developed to test bio augmentation or addition of natural microorganisms as a means of improving oils sands processing including separation of hydrocarbons form particles as well as improved settling of tailings. In this work we tested BioTiger™, a patented consortium of natural bacteria tested & isolated from a remediation project at a Polish Oil Refinery, with Canadian oil sands and tailings. Results demonstrated bio augmentation of BioTiger™ to oil sands and tailings respectively increased separation of organic carbon from particles in oil sands and enhanced settling with tailings with improved water quality.

Battelle Third International Symposium on Bioremediation and Sustainable Environmental Technologies

Location: Miami, Florida
Date: May 2015 (ORAL Presentation)
Sponsor: Battelle Third International Symposium
Influence of Bio augmentation on Canadian Oil sands and Tailings Processing
R.L. Brigmon, C. Milliken, M. Moultrie, J. Fox, and W. Simpson

ABSTRACT
Background/Objectives. Canadian oil sands are a major source of oil but their processing results in tailings ponds and associated runoff water that contain contaminants of concern (COCs) including polyaromatic hydrocarbons (PAHs). The main concerns are mature fine tailings (MFT) composed of residual hydrocarbons, water and fine clay. Tailings contain COCs including heavy metals, naphthenic, and PAHs. Solvents are also used in processing that end up in the tailings ponds as well. Naphthenic acids and PAHs degrade very slowly and pose a long-term threat to surface and groundwater as they can be transported as suspended solids in the MFT. The objective here is to improve processing of oil sands and resultant tailings ponds and associated COCs through bio augmentation. Increasing biodegradation and separation of hydrocarbons from clay,

sand, and other particles would enhance settling of the MFT, improving water quality in the pond effluent, and potential recover hydrocarbons.

Approach/Activities. Canadian Athabasca oil sands and tailings were used in bio augmentation evaluations. For laboratory tests, BioTiger™, a patented microbial consortium that can metabolize PAHs, was applied in bio augmentation tests. Untreated oil sands, tailings, and *Escherichia coli* were used as controls. BioTiger™ is made up of 12 aerobic bacteria selected based on their enzymatic and/or bio surfactant production. Of the 12 cultures tested five were shown to completely degrade phenanthrene, a PAH, as a sole carbon and energy source in 24 h. Bio augmentation of Canadian Athabasca oil sands tailings resulted in increased (5X) microbial densities but active metabolism as measured by respirometer was not observed without the addition of yeast extract (1g/L). Microscopic techniques were combined with Mass Spectrometry-Gas Chromatography (GC-MS) to evaluate BioTiger™ interactions with the tailings and oil sands. The individual BioTiger™ strains were tested in microbial media as well as with the tailings to examine relative growth rates.

Results/Lessons Learned. Results demonstrated bio augmentation of BioTiger™ increased separation of organic carbon from particles in oil sands and enhanced settling with reduced MFT for improved water quality. It was demonstrated that increasing the ratio of oil sands tailings to BioTiger™ decreased microbial viability up to 50%. Oil sands tailings can have inhibitory effects so concentrations and turnover rates must be taken into consideration for remediation efforts. There were natural bacteria observed in the oil sands and tailings, but were not very active nor did they respond to any of the treatments applied here. The tailings and oil sands bio augmentation testing described here has the potential to ameliorate the environmental impact of oil sands processing and improving overlaying water quality.

Subproject Title #2: Enhancement of Environmental Remediation Monitoring and Student Training at Savannah River Site

Principal Investigator: Dr. John B. Williams

Name of Conference	Location of Conference	Date of Conference	Conference Sponsor
SC Academy of Sciences Annual Meeting- 2011	South Carolina State University, Orangeburg, SC	April 16, 2011	SC Academy of Sciences
ALLIANCE FOR MINORITY PARTICIPATION (SCAMP) ANNUAL SCIENCE, ENGINEERING, & RESEARCH CONFERENCE	South Carolina State University, Orangeburg, SC	November 4, 2011	SC Alliance For Minority Participation
United States Department of Energy Grantee Conference	Benedict College Columbia, SC	November 21, 2011	The Triangle Association of College
DOE-EM/HBCU Conference	South Carolina State University (SCSU)	April 11, 2012	South Carolina State University
SRNL-PARTNERING	SRNL Aiken, SC	January 31, 2013	SRNL-DOE
SC ACADEMY OF SCIENCES ANNUAL MEETING -2014	Trident Technical College, North Charleston, SC	April 5, 2014	SC Academy Of Sciences
Partnering for Synergy and Success 2014 Research Collaboration Workshop and Poster Session	SRNL Aiken, SC	April 24, 2014	SRNL-DOE

United States Department of Energy Grantee Conference
Location: Benedict College, Columbia SC
Date: November 21, 2011

SC ACADEMY OF SCIENCES ANNUAL MEETING- 2011
Location: South Carolina State University, Orangeburg, SC 29117
Date: April 16, 2011
Sponsor: SC Academy of Sciences

Products / Presentations:

Relative Progress Of Natural Attenuation Of Trichloroethylene Within A Stream Hyporheic Zone (Poster)

Charmaine Wells and John B. Williams
Department of Biological & Physical Sciences, South Carolina State University, Orangeburg, SC 29117

ABSTRACT
Byproducts from cold war production of plutonium and tritium at the DOE Savannah River Site (SRS) include many industrial chemicals as well as radiological contamination. These wastes are currently undergoing cleanup and South Carolina State University (SCSU) in collaboration with the University of Georgia Savannah River Ecology Lab (SREL) are assisting cleanup activities through research into the effectiveness of natural biochemical processes in helping breakdown wastes. These ecosystem actions are termed natural attenuation and this field is becoming more prominent in environmental science as a potentially low-cost method of waste cleanup. Crucial to this process is an accurate assessment of the effectiveness of natural attenuation and the suitability of local environmental conditions to support it. Our research focused on degradation of trichloroethylene (TCE), a common contaminant solvent. Although breakdown products of TCE including DCE and vinyl chloride were detected for groundwater beneath the Pen Branch watershed at SRS, persistent, concentrations of TCE and some 1,1-DCE along the plume perimeter indicated the rate of plume movement exceeded natural attenuation rates. To more accurately determine effectiveness of natural attenuation to degrade TCE, we decided to directly measure MNA conditions in the hyporheic zone, the saturated groundwater zone beneath the actual streambed. Our efforts focused on water chemistry variables using electrode methods (by Hydrolab^{TM}) and included: temperature, pH, redox, conductivity, and dissolved oxygen. Fe+2, SO4, NH3, and H2S measurements were also conducted using Hach TM kits. Interesting patterns of variability were found for relative TCE degradation products between different hyporheic zone holes. However, general chemical conditions were found to be favorable for further natural attenuation of TCE. Since our study was only conducted during summer months, additional sampling should be done during cooler seasons to determine how natural attenuation effectiveness might change with season.

Biome (Poster)

Shannon Crawford, Alyssa Murray, Harry L Reed, and Alexandria. Hezekiah
Department of Biological & Physical Sciences, South Carolina State University,
Orangeburg, SC 29117

ABSTRACT

Urban ecology is becoming an increasing important science as previously natural habitats are encompassed by commercial and residential development. Managing environmentally-friendly building practices enhances not only the quality of urban-suburban life, but often enables native species to still thrive in set-aside preserves. One of the key issues in determining the proper ratio of set-aside natural areas to developed landscape is the amount of land or water surface area required. Native species are able to utilize patchy habitat, but can be seriously impacted by barriers such as transportation corridors. The primary objective of our study was to utilize GPS technology to determine habitat areas within the South Carolina State University campus and relate their positioning to ongoing development activity and man-made barriers. A secondary objective of this project was to enable STEM majors to explore the capabilities of handheld GPS systems (Garmin ^{tm} Rhino) in mapping and measuring environmental conditions and analyzing the data with GIS software. Our procedure utilized pairs of students in teams mapping areas of the campus in three general categories: 1) stable developed, 2) ongoing development, and 3) natural successional habitat. When possible, observations were also made of animal species within the habitats. This GPS unit allowed real-time communication between student teams; providing information for an eventual on-campus environmental sciences trail that will document not only natural habitat, but also acute and chronic environmental impacts of development and campus operations.

Establishing A Multihabitat Microclimate Monitoring System for Advancing Environmental Education (Poster)

Shontae S, Samuel, Alejandra. M. Chirino, William Dumpson, Hassan Black, and Ahmed Majekodunmi,
Department of Biological & Physical Sciences, South Carolina State University,
Orangeburg, SC 29117

ABSTRACT

While larger-scale environmental events like Global warming, earthquakes, and tsunamis capture the news and imagination of the general public, much smaller-scale, but fascinating processes exist in the realm of microclimate. Soil temperatures can vary dramatically within a few cm of the sunlit soil surface. Air temperature and relative humidity can be markedly different just above the leaf surface compared to several cm within the plant canopy interior. Aquatic habitats generally enjoy a more stable temperature compared to the surrounding atmosphere, but can display much sharper diurnal cycles in chemistry than air. In order for students to gain a greater appreciation for microclimate and its local impacts on habitat and the physiology of species residing there, our student team has been working to establish a series of remote and electronically monitored microclimates. Local atmospheric conditions were sampled at several habitats and compared with a major computerized weather station that served as our continuous local data base. GPS units with two-way radio capacity were utilized to enable students to make simultaneous measurements at different terrestrial microclimates under the same physical settings (e.g. soil depth degree of plant cover, or height above ground). Additional efforts are

underway to establish an aquatic microcosm close enough to ecology classroom facilities to enable wired or wireless monitoring capabilities. The long-term objective of our project is to establish: 1) a hands-on protocol for science classes to explore the intricacies of microclimate in-situ and 2) to establish a remotely monitored microclimate data base; enabling classes to compare year to year changes in the different microhabitats.

SC ALLIANCE FOR MINORITY PARTICIPATION (SCAMP) ANNUAL SCIENCE, ENGINEERING, & RESEARCH CONFERENCE
Location: South Carolina State University, Orangeburg, SC 29117
Date: November 4, 2011
Sponsor: SC Alliance For Minority Participation

Products / Presentations:

Charting A Trail for Ecology on Campus (Poster)
Alyssa Murray
Department of Biological & Physical Sciences, South Carolina State University, Orangeburg, SC 29117

ABSTRACT

Urban ecology is becoming an increasingly important science as existing natural habitats are encompassed by commercial and residential development. At South Carolina State University, the campus was experiencing similar changes as construction of new buildings had a significant effect on the campus' biome. Managing environmentally-friendly building practices enhances not only the quality of urban- suburban life, but it often enables native species to still thrive in set-aside preserves. One of the key issues in determining the proper ratio of set aside natural areas to developed landscape is the amount of land or water surface area required. The recent construction projects were not designed to in cooperate nature but rather, nature was left as an "after- thought". However, native species are able to utilize patchy habitat, but can they can also be seriously impacted by barriers such as transportation corridors. We have to ask ourselves," To what extent, if at all, can local birds and other small animals utilize the man made "green ways" and plant habitats around campus?"
The primary objective of this study was to utilize GPS technology to determine habitat areas within the SCSU campus and relate their positioning to ongoing developmental activities and man-made barriers. Handheld GPS systems (Garmin ^{tm} Rhino) allowed for easy mapping and measuring environmental conditions to take place while also allowing real time communication between student teams. Stable developed areas, areas with ongoing development and natural successional habitats were observed and areas suitable for a trail were noted. Collected data was then synced with GIS software.

*End of the Cold War Marks Beginning of Student Remediation Training (*Poster)
Alejandra Chirino and Shequila Elmore
Department of Biological & Physical Sciences, South Carolina State University, Orangeburg, SC 29117

ABSTRACT

Since 1950, Savannah River Site (SRS) has operated with the mission to produce nuclear materials for national defense, medical research, and space exploration. As a result of past

disposal practices, soils, surface water and ground water have been contaminated by releases of hazardous substances at SRS. The US Department of Energy (DOE) is in charge of conducting an Environmental Protection Agency (EPA)-mandated compliance monitoring of contaminant plumes flowing underneath this site and are using enhanced bioremediation to remediate soils and ground water contaminated with pesticides and Polychlorinated Biphenyl's (PCB's) found in sites such as Chemical, Metal, and Pesticide (CMP) pits. Their goal of groundwater remediation is to take actions to restore contaminated groundwater to its intended beneficial use and to protect human health and the environment. SCSU researcher, Dr. John B. Williams and his interns have teamed up with the DOE whose main focus is on the ground water transport of contaminants into the valley of Pen Branch Stream. They have determined how well nature breaks down manmade pollution which has helped SRS to determine plume movements and the relative effectiveness of natural attenuation in cleaning up a plume containing chlorinated solvents from a former chemical waste pit. Consequently, not only does this affect our tax dollars in a positive way, but it helps preserve our ecosystems from impacts of constructed cleanup operations. "Their work has proven valuable to SRS cleanup efforts and one official described some of their results as worth their weight in gold."

Hammering the Hyporheic Zone for Groundwater Samples (Poster)

Alton Allen
Department of Biological & Physical Sciences, South Carolina State University,
Orangeburg, SC 29117

ABSTRACT

A dynamic zone of exchange between subsurface groundwater and flowing surface water in streams are known as the hyporheic zone. The saturated sediment layers in streams from surface waters may not actually be in contact with the subsurface groundwater layers. Contaminants in groundwater may not always outcrop into surface waters along expected stream reaches. For this reason, we developed methods of accessing the hyporheic zone beneath streams without allowing surface water to penetrate into groundwater layers.
Before collecting water samples you first have to secure a PVC pipe in the soil. In each station location there are 2 pipes installed at 30cm and 60cm. The reason for two different pipes at two different depths is to the see the correlation in depth and amount of VOC's in the groundwater. The tools needed for pipe insertion are a sledge hammer, 4x4 plank, and 3ft. PVC pipes. When installing the pipes make sure the areas is clear of debris and all safety measure are followed. While the pipe is standing on its end lay the plank across the head of the pipe flat. Make sure hands are clear from area of compact with the sledge hammer. Drive the pipe at least half of its length. After pipe is correctly installed the extra soil in the pipe must be removed. With the auger tool shown in the picture. After the hole is cleared the PDB bags will be inserted. Each PDB bag has a corresponding numbers with the station location to insure correct data.

The Safety Factor as a Research Component (Poster)

Charmaine Wells
Department of Biological & Physical Sciences, South Carolina State University,
Orangeburg, SC 29117

ABSTRACT

Safe research protocols are essential for studies involving any level of potential hazards. Not only does a complete safety audit provide for the safety of the researchers and any test subjects,

but a regulated safety protocol also creates a more orderly research process. In our research at Savannah River Site we were very careful to follow safety protocols due to the multiple hazards impacting our research location. We practiced safety rules to avoid snake bits, bug bites, trips/falls, or even hurting one another. Our safety uniform or personal protective equipment (PPE) consisted of: gloves: to protect our hands from contaminants or any other bites; orange safety vest: to spot each other outside the work area; pith helmet: to protect from sunlight or anything that may become a hazard to our head; snake chaps: protect us from the ankle up to our waist for snake bites, snake boots: protected us from snake bites from our calves to our feet. Since we have been careful to practice safety protocols, we have been known for our 12 years incident free safety record.

This safety record not only documents the success of S.C. State University interns in following proper procedures, but it also reflects the careful precision of all aspects of our sampling. This research work takes place in both the field and the lab with different types of hazards. By following a careful research plan, not only is safety maintained, but the quality and precision of collected data are also enhanced.

*Utilizing the Edisto River as an Outdoor Laboratory (*Poster)

David Anderson
Department of Biological & Physical Sciences, South Carolina State University,
Orangeburg, SC 29117

ABSTRACT

South Carolina State University (SCSU) environmental interns worked to help develop ecological opportunities for University classroom programs. Experiences included developing a field trip to the Edisto River as an educational learning opportunity on conservation. Conservation is a movement to protect animals, fungi, plants and their habitats from being extinct. The Edisto River Basin Task Force is actively pursuing a project in support of these efforts. "The Edisto river, first named by the native Americans who lived beside it, is one of the longest free flowing blackwater rivers in the United States" (SCDNR Designated Scenic Rivers, 2011). Within the United States the Edisto River is one of the few remaining few remaining blackwater stream ecosystems in the United States that is in good condition (SCDNR Designated Scenic Rivers, 2011). It is also the goal of SRS to help preserve nature and ensure a clean and safe environment. While at the Edisto River, students took samples of water to test and identify its quality including PH levels as well as try to find any living creatures in the river. As part of the sampling process, a Hydrolab Surveyor was used. A Hydrolab surveyor is a water quality sensor that measures various properties in the water and helps generate reliable data through the water cycle (Hach Hydromet, 2011). After a brief demonstration on how to use a Hydrolab Surveyor, students performed water sampling to use for testing.

In addition to water sampling students also performed a sampling of living creatures, such as fish, tadpoles, and turtles through casting a net into the river. Observations were made of the sample of animals to determine their wellbeing and their quality of life for them within the river.

Developing Passive Diffusion Bags as a Primary Contaminant Sampling Tool (Poster)

Demanti O'Bryant
Department of Biological & Physical Sciences, South Carolina State University,

Orangeburg, SC 29117

ABSTRACT

A particularly useful tool for sampling low levels of volatile contaminants (VOC) is sealed polyethylene bags of deionized water. Our project was designed to test different sizes of passive diffusion bags (PDB) for their ability to hold water under environmental sampling conditions and allow for diffusion of any contaminants present in groundwater soils.
Collections of potentially contaminated soil from auger were stored in vials. Samples of water possibly containing volatile organic compounds (VOCs) were also collected by transferring the water from the passive diffusion bags (PDBs) into septa-seal vials. First we cut plastic holders and sealed one end of the holder (pressure/heat sealer used). Next, the holder, now made into a bag, was filled with distilled water. We then sealed the other end of the bag, now filled with water. Lastly holes were punched near top in order to group multiple bags and label them. First, the screening was folded in half (long ways) and then creased on the open sides leaving one of the shorter sides open. Holes were punched in the creased sides accompanied with an insertion of "zip ties" into the holes to label and close the PDB screen. The screen was then more easily identified and match with sample vials.
The PDB screen was then used to house grouped PDBs (of the same label) and placed into augered holes in the field. The PDB screens were lowered into a specific hole that had been augered according to station label. The PDB screens were anchored in the hole by a sealed-bottle containing rocks or a combination of rocks and water. After a minimum of three weeks exposure time, the PDB's were recovered and their water contents placed into septa-seal vials for GCMS determination of VOC concentrations.

Recent Progress in Intern Remediation Research (Poster)

Derek Best
Department of Biological & Physical Sciences, South Carolina State University,
Orangeburg, SC 29117

ABSTRACT

Extensive training opportunities at DOE's Savannah River Site (SRS) have helped South Carolina State University (SCSU) student interns advance their understanding of remediation technologies while at the same time aiding SRS remediation efforts. A main study area was the SRS chemical, metal, and pesticides) pits (CMP pits). This particular waste site was designated as a RCRA/CERLA waste unit site; adding to the significance of the student research efforts. Here the interns conducted plume remediation research on volatile organic compounds (VOC). As shown in these graphs VOC showed wide variability at the different Pen Branch stations. The interns worked hard arguing holes nearly a meter in depth to place PDB sampling bags within them. The interns also took groundwater samples from previous holes, through PVC pipes, with the use of a peristaltic pump. A peristaltic pump a type of positive displacement pump used for pumping an assortment of fluids. The fluid is then contained within a flexible tube fitted inside a circular pump casing. This technology prevented the water sample from
contacting any foreign surfaces before being placed into analytical vials. Final results were determined in collaboration with the Savannah River Ecology Lab using their GCMS

Environmental Education (Poster)

Hassan Black
Department of Biological & Physical Sciences, South Carolina State University,
Orangeburg, SC 29117

ABSTRACT

This research project was setup in order for students to gain a greater appreciation for microclimates and their local impacts on habitats and the physiology of species residing there. Student teams have been working to establish a series of remote and electronically monitored micro climates.

A microclimate is a small but distinctly different climate within a larger area. For example, in a garden, a spot which is sunny and protected from the wind could be considered a micro climate, as it will be significantly warmer than the rest of the garden for most of the year. The microclimate in the example above would be considered extremely small, but they can also get much larger; valleys and hills are classically micro climates, due to a variety of factors which cause their weather to be different from the more general weather in the region.

Several different instrumental methods and systems were presented to students to help gain better insight into the reading of micro climate conditions. Wireless monitoring weather stations (weather hawk) can provide continuous monitoring of basic climate parameters that could be compared to local atmospheric conditions sampled at several different habitual sites. Basic climate conditions that are monitored and reported are barometric pressure, relative humidity, temperature, and wind speed, and direction.

In order to help better process raw data from weather hawk and other sources. Students will work together and construct a computer from the ground up. This project will teach students about the many functions and inner working of computers will at the same time helping facilitate the project. The computers will ultimately be used to process and compile the raw data from weather hawk and other sources.

Collaborative Research Training at Savannah River Site (Poster)

Jarvie Robinson
Department of Biological & Physical Sciences, South Carolina State University,
Orangeburg, SC 29117

ABSTRACT

Every year The United States Department of Energy teams up with The Savannah River Site to develop a summer research internship for Bioremediation. South Carolina State University has a long history of experience for the job. Dr. John B. Williams of the Department of Biological and Physical Sciences selects interns through a competitive process.

The United States Department of Energy Savannah River Site sign is seen as soon as you turned into the site. Dr. Williams and some of his student interns were in front of a Nuclear Reactor and Admissions Stack located on the Site. The Nuclear Reactor was used about 60 years ago in manufacturing nuclear Weapons. The student interns worked out in the field at Pen Branch of Savannah River Site doing hands on training and were mentored by Dr. Williams and Dr. Gary L. Mills. Intern training in the field and lab were essential to this research internship.
Training in the field was as important as training in the lab. The most important thing about field training was safety. Dr. Williams encouraged field safety at all times. Lab safety was also very important for the student interns. After samples were pulled from tree coring in the field, they were

transported to the Savannah River Ecology Laboratory for analysis by using the Gas Chromatography-Mass Spectrometry Machine. In simple terms this machine is a separation technique used in chemistry to separate compounds by using an inert gas (Helium)

Behavioral and Physiological Aspects of Safety Preparedness (Poster) Raymond Lewis Claybrooks Jr
Department of Biological & Physical Sciences, South Carolina State University, `
Orangeburg, SC 29117

ABSTRACT

Savannah River Site (SRS) values safety more than the product itself. Our training has determined that if we were doing our tasks safely, we would also be doing them correctly. While we were out in the field, we practiced many safety techniques such as eating safe foods and wearing the proper equipment such as PPE.
In the field we drank a lot of water to keep us hydrated and ate freeze pops to keep our blood sugar level up, we also ate salty foods during periods of perspiration to replenish the sodium levels.
We wore protective gloves while dealing with potentially contaminated soil to maximize safety. We also wore insect repellant, snake chaps, orange safety vests and spiff helmets. We packed a survival kit that included a first aid kit, eyewash, signal horn, and radios.
We made sure to keep a safe distance between the person hammering and holding the pipe. Before we started to work, we did a five-foot radius check for water moccasins and copper head snakes, as they are very dangerous. These few safety precautions have proven to be very beneficial as the South Carolina State University intern team has maintained a safety record of thirteen years accident free.
I have come to appreciate the safety first motto of SRS making me feel valued more than the product.

Cross Contamination Prevention: A Critical Research Protocol (Poster) William Dumpson
Department of Biological & Physical Sciences, South Carolina State University, Orangeburg, SC 29117

ABSTRACT

One of the main concerns that arise out of scientific experiments is the accuracy of the results. Cross contamination alters the outcome of the experiment, and the results of that experiment will not be representative of the actual conditions. The breaking down of pollution by bacteria and plants is called natural attenuation and is one form of green technology that a SC State University research team has determined will assist with the cleanup efforts at the US Department of Energy (DOE) Savannah River Site (SRS). Under Dr. Williams we monitored the levels of natural TCE degradation into breakdown products such as DCE and VC, in order to view the effectiveness of natural attenuation and suitability of local environment. These ecosystem actions are termed natural attenuation and this field is becoming more prominent in environmental science as a potentially low-cost method of waste cleanup. For us to accurately determine the effectiveness of natural attenuation and suitability of local environments to sustain it, the results must be a clear representation. To achieve that, we employed certain field steps and Lab procedures to prevent cross contamination and ensure purity of sample. At every location, each hole had a dedicated pipe hose. To make sure the hoses did not contaminate the results, each of the hoses were cleaned with Alconox^{tm}. The pipe intake screens were covered with air

filters. All of these procedures prevent contaminants from one sampling area from washing into another and ensuring the accuracy of the results our research team generated.

DOE-EM/HBCU Conference
Location: South Carolina State University, Orangeburg, SC 29117
Date: April 11, 2012
Sponsor: DOE-EM / SC State University Office of Sponsored Programs

New Skills from New Technology: Developing an EM Gas Chromatography Mass Spectrometry Lab (Poster)

Brande Hicks, Alejandra Chirino, William Dumpson, and Hassan Black
Department of Biological & Physical Sciences, South Carolina State University, Orangeburg, SC 29117

ABSTRACT

Two growing employment fields within environmental management (EM) are environmental remediation and waste management, both of which rely increasingly upon advanced technologies like gas chromatography-mass spectrometry (GCMS) to assist the decision-making process. The goals of our new GCMS Lab are to: 1) highlight the diverse appli-cations of Gas Chromatography-Mass Spectrometry (GC/MS) for environmental remediation-related disciplines;
2) train EM student interns in research applications of GCMS; 3) train faculty to develop EM relevant syllabus components that will expose additional students to (GCMS) use; and 3) to eventually provide students with hands-on GCMS experiences as the course components are implemented. A main focus of the GCMS work will address distinguishing between different organic compounds, particularly volatile organic compounds (VOC). To expand the use of our new Gas Chromatography-Mass Spectrometry lab for EM-related research and classroom instruction, a Faculty Training Institute was conducted collaboratively between S.C. State University and University of South Carolina. Both faculty and student interns received vital training. Dr. Judith Salley helped to develop this DOE-EM Faculty Institute as a model to expand EM-related outreach to a larger segment of our student audience. As a part of this DOE-EM project work at SCSU, this new GCMS lab in Davis Hall Annex is being managed by a new Post-Doctoral Re-searcher. This new Post-Doc will supervise EM research and student training on the GCMS and assist faculty in GCMS usage. Instructors participating in the GCMS Faculty Training Institute will therefore have access to state of the art technology to enhance their students' class experiences and for research. The GCMS Faculty Training Institute not only achieved the goal of expanding the use of the lab for EM-related research, but it also brought researchers together from all majors of STEM curricula. 'Brainstorming' sessions were

Products / Presentations: (DOE-EM/HBCU Conference Continued….)

particularly valuable since they brought together disciplines such as Engineering and Biology that might not otherwise have collaborated.

EM Technology Transfer: Tree Coring as A Natural Sampler of VOC Plumes (Poster)
Jarvie Robinson, Derek Best, and Russell Willis
Department of Biological & Physical Sciences, South Carolina State University, Orangeburg, SC 29117

ABSTRACT

Chlorinated solvents, byproducts from cold war production of plutonium and tritium at the DOE Savannah River Site (SRS) have contaminated groundwater in some watersheds. These wastes are currently undergoing cleanup and South Carolina State University (SCSU) in collaboration with the University of Georgia Savannah River Ecology Lab (SREL) is assisting cleanup activities through research into the effectiveness of natural biochemical processes in helping break down wastes. Our EM tree coring research was designed to investigate new technologies that might enhance the ongoing SCSU efforts in SRS C-Area. General ecosystem remediation actions are termed natural attenuation and this field is becoming more prominent in environmental science as a potentially low-cost method of waste cleanup. Trees acting as environmental samplers represent an economically and ecologically attractive approach to environmental monitoring. Additionally, trees can act in the process of phytoremediation to actually help degrade plume contaminants. Crucial to the process of determining the efficacy of natural attenuation is an accurate assessment of attenuation effectiveness and the suitability of local environmental conditions to support it. For this reason, our project sampled trees located at different distances from the estimated plume fringe. Breakdown products of perchloroethylene (PCE) and trichloroethylene (TCE) including dichloroethylene (DCE) and vinyl chloride (VC) were detected for groundwater beneath the Pen Branch watershed by the ongoing SCSU monitoring project. Our tree core analyses with SREL only focused on degradation of PCE and TCE, com-mon contaminant solvents. Since our study was only conducted during summer months, additional sampling should be done during cooler seasons to determine how tree uptake effectiveness might change with season and leaf loss.

Products / Presentations:

Effectiveness of Passive Diffusion Bag (PDB) Samplers in VOC Detection (Poster)
Ray Claybrooks and Alton Allen
Department of Biological & Physical Sciences, South Carolina State University, Orangeburg, SC 29117

ABSTRACT

Many industrial chemicals as well as radiological contamination are waste byproducts from cold war production of plutonium and tritium at the DOE Savannah River Site (SRS). These wastes are currently undergoing cleanup and South Carolina State University (SCSU) in collaboration with the University of Georgia Savannah River Ecology Lab (SREL) is assisting cleanup activities through research into the effectiveness of natural biochemical processes in helping breakdown volatile organic com-pounds (VOC). These ecosystem actions are termed natural

Products / Presentations: (DOE-EM/HBCU Conference Continued….)

attenuation and this field is becoming more prominent in environ-mental science as a potentially low-cost method of waste cleanup. Crucial to this process is an accurate assessment of the effectiveness of natural attenuation and the suitability of local environmental conditions to support it. This component of our re-search focused on determining the suitability of using passive diffusion bags (PDB) to sample groundwater plumes versus grab samples from hole waters. Advantages of PDB's include being able to detect VOC even when augered sample holes are dry. VOC vapors diffusing through soil can enter PDBs. PDB water containing any VOC's is then later analyzed using Gas Chromatography-Mass Spectrometry (GCMS). A key question that our project is addressing is how closely do VOC measurements from PDB samples compare to water grab samples from wells or augered holes. We were particularly concerned that the unique sampling approaches that we have been conducting for the Pen Branch hyporheic zone and vadose zone would give comparable results for both grab samples and PDB samples. Breakdown products of perchloroethylene (PCE) and trichloroethylene (TCE) including dichloroethylene (DCE) and vinyl chloride (VC) were detected for groundwater beneath the Pen Branch watershed at SRS. These compounds were found in comparable concentrations for both hole water grab samples and PDB samples. These results indicated that a holding time of two to three weeks for PDB samplers was sufficient for PDB's to reach an equilibrium with existing groundwater VOC concentrations. Interesting patterns of variability were found for relative TCE degradation products between different hyporheic zone holes. However, general chemical conditions were found to be favorable for further natural attenuation of TCE in the Pen Branch hyporheic zone. PDB's were verified to give accurate measures of groundwater VOC.

SC ACADEMY OF SCIENCES ANNUAL MEETING -2014
Location: Trident Technical College, North Charleston, SC
Date: April 5, 2014
Sponsor**:** SC Academy Of Sciences

Effectiveness Of Passive Diffusion Bags Versus Ambient Groundwater Samples For VOC Plume Monitoring (Poster)
John B. Williams, Andrew W. McCray, Walter J. Williams
Department of Biological & Physical Sciences, South Carolina State University, Orangeburg, SC 29117

ABSTRACT

Passive diffusion bags (PDB) are an effective way to collect volatile organic compounds (VOC) from surface and subsurface waters especially when subsurface conditions hinder the collection of adequate water volumes. PDB's are typically deployed for two weeks in a sampling well to accumulate VOC's until reaching equilibrium with ambient waters. Since shallow groundwater flows surrounding the PDB's will vary depending upon conditions such as ambient rainfall, PDB concentrations represent a temporally integrated sample. For this reason, PDB's may give a more accurate representation of average VOC conditions at a location than temporally separated grab samples. Scheduled grab samples may occur after locally high volume antecedent rainfalls or after temporary drought conditions. In either case, a more extreme picture of VOC levels may emerge. The primary objective of our study was to determine whether VOC concentrations

collected using PDB's differed significantly from pumped samples from the same hole immediately prior to PDB insertion and pumped samples from the same hole at PDB recovery time. It was hypothesized that the mean VOC of the before and after pumped water samples should approximate VOC levels in the PDB. This methodological study was an integral part of our overall investigation on the suitability of natural attenuation to remediate VOC plumes originating from an EPA Superfund site "operable unit" at Savannah River Site, SC. This waste disposal area, CMP Pits, was closed in 1979 when the pits were closed and backfilled. Subsequent monitoring indicated that perchloroethylene (PCE) and trichloroethylene (TCE) plumes were seeping beneath the vadose zone in groundwater reaching the Pen Branch valley below. As a part of the overall sampling program supporting compliance monitoring for CMP Pits, this study will help to provide the most accurate approaches for documenting natural attenuation of VOC's. The EPA has found natural attenuation to be an acceptable mode of achieving compliance to regulatory standards as long as sampling documents its adequacy. Our study was replicated from 2011 to 2013 and VOC samples were mainly analyzed using GCMS purge and trap methods. In general, VOC concentrations showed similar trends for both methods (i.e. stations with higher VOC levels were higher than other stations under both methods. However, concentrations in the PDB's usually exceeded VOC levels for initial and final pumped water samples from the same holes (e.g. Station 5B-60 had 100 ppb cis-dichloroethylene (cis-DCE) and 3.0 ppb PCE in PDB's while mean grab sample cis-DCE was 60.5 ppb and 1.5 ppb PCE). However, some holes had more similar results for PDB sample versus hole water sample (e.g. Station 5E had 11 ppb cis-DCE in PDB's while mean grab sample cis-DCE was 15 ppb). For practical purposes, we accepted our hypothesis that both methods yield similar conclusions for VOC variations between locations. However, further studies should address these comparisons over shorter time intervals. Our PDB's were incubated for up to three weeks for some holes.

Sensitivity Of Tree Core Sampling In Detecting Trichloroethylene Groundwater Plumes (Poster)

John B. Williams, George B. Taylor, Quinn I. Thomas, Quincy I. Pickett-Stokes,
and Elizabeth Ashley Shull[1]
Department of Biological & Physical Sciences, South Carolina State University
[1]Savannah River Nuclear Solutions

ABSTRACT

Natural attenuation includes any ecosystem functions that can reduce contaminant loads in the surface and subsurface environment. Programs by the EPA, other government agencies, and industry are carefully documenting the completeness of these natural pollution-reduction pathways through a process called "monitored natural attenuation". Advantages to end-users from successful natural attenuation include reduced clean-up costs and often more esthetically pleasing work-sites. Our project was conducted near an EPA Superfund site "operable unit" at Savannah River Site, SC. The major impact from this site was trichloroethylene (TCE) groundwater plumes moving downslope to the Pen Brach wetlands valley. The focus of our study was to determine the utility and effectiveness of tree core sampling to detect plume flow and evidence of TCE degradation. Trees play a major role as a form of natural attenuation in a special subcategory, phytoremediation. Phytoremediation primarily involves trees serving as natural "pumps" to move groundwater from the rhizosphere to the leaves and into the

Products / Presentations: (SC ACADEMY MEETING -2014 continued….)

atmosphere as evapotranspiration. Along with this uptake and transport, some tree enzymes have been shown to degrade TCE to breakdown compounds along the TCE dichloroethylene (DCE)□vinyl chloride (VC) pathway. However, these mechanisms are less completely documented than the bacterial reductive dechlorination pathways in natural attenuation. Collectively these compounds are classified as volatile organic compounds (VOC). Our primary objective was to determine the utility of coring trees in the Pen Branch floodplain to detect TCE plume movements and degradation. If this methodology were shown to be as reliable as shallow well construction, monitoring results might be obtained more quickly with less expense than hole-auguring and pumping. Our methods utilized standard tree coring methods with extracted cores being placed into septa-seal vials and stored on ice for later GCMS analysis. An additional objective was to determine whether tree roots radiating in different directions from the trunk might provide even more detailed information on spatially small scale plume conditions. The TCE parent compound, perchloroethylene (PCE) and DCE were present in significantly higher concentrations in tree tissues than nearby piezometer reference stations. Roots radiating outwards in different compass directions sometimes showed greater than a10X difference in VOC between roots for the same tree (e.g. 1,1 DCE varied from 96 ppb to 4 ppb between roots). Replicate sampling of the same trees on different dates was consistent for tree to tree VOC levels, but was inconsistent with regards to which root direction display highest VOC.

Long Term Natural Attenuation Effectiveness In Remediating A TCE Groundwater Plume Site
(Oral Presentation)

John B. Williams and Elizabeth Ashley Shull[1]
Department of Biological & Physical Sciences, South Carolina State University
[1]Savannah River Nuclear Solutions

ABSTRACT

In recent decades, field studies have continued to document the efficacy of natural attenuation as a ‘green’, cost-effective technology for remediating contaminated sites. When applicable, the EPA has found natural attenuation to be an acceptable mode of achieving compliance to regulatory standards. While natural attenuation can include any ecosystem function that reduces contaminant loads in the surface and subsurface environment, it is focused on microbial biochemical pathways. Our study was replicated several years near an EPA Superfund site “operable unit” at Savannah River Site, SC. This waste disposal area, CMP Pits, was in operation from 1971 until its closure in 1979 when the pits were closed and backfilled. However, monitoring well data indicated that perchloroethylene (PCE) and trichloroethylene (TCE) had seeped beneath the vadose zone and formed groundwater plumes reaching the Pen Branch valley below. Although ‘hot spots’ of TCE were found within the Pen Branch floodplain, it was unknown just how the flow pattern was entering Pen Branch and to what degree natural attenuation was destroying the contaminant load. To accurately predict rates of natural attenuation for these plumes, it was vital to determine plume flow patterns, suitability of chemical and microbial conditions, and degradation rate seasonality. Intensive sampling of different reaches of Pen Branch from 2005 to 2013 addressed these questions for the critical hyporheic zone beneath Pen Branch and adjacent floodplain. Collectively PCE, TCE, and their degradation products are labeled as volatile organic compounds (VOC) and a favorable trend of contaminant reduction was detected. Total VOC concentrations at some stations have declined

Products / Presentations: (SC ACADEMY MEETING -2014 continued….)

by >25% and concentrations of vinyl chloride (VC), a nearly-final stage degradation product increased from 0.0 ppb to >20 ppb. However, flow patterns are complex and plumes do not directly outcrop into Pen Branch surface waters, but emerge into the stream through pathways in the porous hyporheic zone. For this reason continued sampling must identify critical depths and downstream locations where plume flows may be more intense. During drought periods with no surface flow in Pen Branch, subsurface plume flows may be flowing downslope in the hyporheic zone.

SRNL-PARTNERING FOR SYNERGY AND SUCCESS: 2014 RESEARCH COLLABORATION WORKSHOP & POSTER SESSION

Location: Savannah River National Laboratory, Aiken, SC Date:
April 14, 2014
Sponsor: DOE-EM and Savannah River National Laboratory

Effectiveness Of Passive Diffusion Bags Versus Ambient Groundwater Samples For VOC Plume Monitoring (Poster)

Andrew W. McCray, Walter J. Williams, and Quinn I. Thomas
Department of Biological & Physical Sciences, South Carolina State University

ABSTRACT

Passive diffusion bags (PDB) are an effective way to collect volatile organic compounds (VOC) from surface and subsurface waters especially when subsurface conditions hinder the collection of adequate water volumes. PDB's are typically deployed for two weeks in a sampling well to accumulate VOC's until reaching equilibrium with ambient waters. Since shallow groundwater flows surrounding the PDB's will vary depending upon conditions such as ambient rainfall, PDB concentrations represent a temporally integrated sample. For this reason, PDB's may give a more accurate representation of average VOC conditions at a location than temporally separated grab samples. Scheduled grab samples may occur after locally high volume antecedent rainfalls or after temporary drought conditions. In either case, a more extreme picture of VOC levels may emerge. The primary objective of our study was to determine whether VOC concentrations collected using PDB's differed significantly from pumped samples from the same hole immediately prior to PDB insertion and pumped samples from the same hole at PDB recovery time. It was hypothesized that the mean VOC of the before and after pumped water samples should approximate VOC levels in the PDB. This methodological study was an integral part of our overall investigation on the suitability of natural attenuation to remediate VOC plumes originating from an EPA Superfund site "operable unit" at Savannah River Site, SC. This waste disposal area, CMP Pits, was closed in 1979 when the pits were closed and backfilled. Subsequent monitoring indicated that perchloroethylene (PCE) and trichloroethylene (TCE) plumes were seeping beneath the vadose zone in groundwater reaching the Pen Branch valley below. As a part of the overall sampling program supporting compliance monitoring for CMP Pits, this study will help to provide the most accurate approaches for documenting natural attenuation of VOC's. The EPA has found natural attenuation to be an acceptable mode of achieving compliance to regulatory standards as long as sampling documents its adequacy. Our study was replicated from 2011 to 2013 and VOC samples were mainly analyzed using GCMS purge and trap methods. In general, VOC concentrations showed similar trends for both

methods (i.e. stations with higher VOC levels were higher than other stations under both methods. However, concentrations in the PDB's usually exceeded VOC levels for initial and final pumped water samples from the same holes (e.g. Station 5B-60 had 100 ppb cis-dichloroethylene (cis-DCE) and 3.0 ppb PCE in PDB's while mean grab sample cis-DCE was 60.5 ppb and 1.5 ppb PCE). However, some holes had more similar results for PDB sample versus hole water sample (e.g. Station 5E had 11 ppb cis-DCE in PDB's while mean grab sample cis-DCE was 15 ppb). For practical purposes, we accepted our hypothesis that both methods yield similar conclusions for VOC variations between locations. However, further studies should address these comparisons over shorter time intervals. Our PDB's were incubated for up to three weeks for some holes.

Sensitivity Of Tree Core Sampling In Detecting Trichloroethylene Groundwater Plumes (Poster)
Students: George B. Taylor, Eddrika Russell, Quincy I. Pickett-Stokes
Department of Biological & Physical Sciences, South Carolina State University

ABSTRACT

Natural attenuation includes any ecosystem functions that can reduce contaminant loads in the surface and subsurface environment. Programs by the EPA, other government agencies, and industry is carefully documenting the completeness of these natural pollution-reduction pathways through a process called "monitored natural attenuation". Advantages to end-users from successful natural attenuation include reduced clean-up costs and often more esthetically pleasing work-sites. Our project was conducted near an EPA Superfund site "operable unit" at Savannah River Site, SC. The major impact from this site was trichloroethylene (TCE) groundwater plumes moving downslope to the Pen Brach wetlands valley. The focus of our study was to determine the utility and effectiveness of tree core sampling to detect plume flow and evidence of TCE degradation. Trees play a major role as a form of natural attenuation in a special subcategory, phytoremediation. Phytoremediation primarily involves trees serving as natural "pumps" to move groundwater from the rhizosphere to the leaves and into the atmosphere as evapotranspiration. Along with this uptake and transport, some tree enzymes have been shown to degrade TCE to breakdown compounds along the TCE including dichloroethylene (DCE) and vinyl chloride (VC) pathway. However, these mechanisms are less completely documented than the bacterial reductive dechlorination pathways in natural attenuation. Collectively these compounds are classified as volatile organic compounds (VOC). Our primary objective was to determine the utility of coring trees in the Pen Branch floodplain to detect TCE plume movements and degradation. If this methodology were shown to be as reliable as shallow well construction, monitoring results might be obtained more quickly with less expense than hole-auguring and pumping. Our methods utilized standard tree coring methods with extracted cores being placed into septa-seal vials and stored on ice for later GCMS analysis. An additional objective was to determine whether tree roots radiating in different directions from the trunk might provide even more detailed information on spatially small scale plume conditions. The TCE parent compound, perchloroethylene (PCE) and DCE were present in significantly higher concentrations in tree tissues than nearby piezometer reference stations. Roots radiating outwards in different compass directions sometimes showed greater than a10X difference in VOC between roots for the same tree (e.g. 1,1 DCE varied from 96 ppb to 4 ppb between roots).

Products / Presentations: (SRNL-PARTNERING FOR SYNERGY -2014 continued….)

Replicate sampling of the same trees on different dates was consistent for tree to tree VOC levels, but was inconsistent with regards to which root direction display highest VOC.

Plume VOC Levels For The Same Holes Via Two Methods: GC-MS Purge & Trap Versus GC-MS Head-Space Analysis (Poster)

Walter J. Williams, George B. Taylor, Andrew McCray, and Eddrika Russell
Department of Biological & Physical Sciences, South Carolina State University

ABSTRACT

Safety, accuracy, and precision are the three primary factors guiding our development of sampling protocols for our remediation monitoring work at Savannah River Site (SRS). As a part of these efforts, we have been developing the capacity for contaminant analyses at our SC State Lab through EM grant funding. Procurement of a new gas chromatography / mass spectrometer (GC/MS) has helped achieve this capability and provided students with advanced training in this important technology. Two common analytical methods for determining concentrations of volatile organic compounds (VOC) in groundwater using GC/MS are the purge and trap method and the headspace analysis method. The EPA has standard protocols for both of these methods, but reports that purge and trap is more commonly used. Some reports indicate that GC/MS purge and trap method may also be more sensitive. The primary objective of our study was to compare the sensitivity of our South Carolina State University (SC State) GC/MS headspace system with a GC/MS purge and trap system. If our SC State system were shown to be comparable to purge and trap, then quick results could be obtained from exploratory sampling related to monitored natural attenuation at Savannah River Site. These efforts would be particularly helpful to the collaborative work with Savannah River Nuclear Solutions (SRNS) for compliance monitoring related to CMP Pits Operable Unit. This methodological study was an integral part of our overall investigation on the suitability of natural attenuation to remediate VOC plumes originating from an EPA Superfund site "operable unit" at Savannah River Site, SC. This waste disposal area, CMP Pits, was closed in 1979 when the pits were closed and backfilled. Subsequent monitoring indicated that perchloroethylene (PCE) and trichloroethylene (TCE) plumes were seeping beneath the vadose zone in groundwater reaching the Pen Branch valley below. As a part of the overall sampling program supporting compliance monitoring for CMP Pits, this study will help to provide the most accurate approaches for documenting natural attenuation of VOC's. The EPA has found natural attenuation to be an acceptable mode of achieving compliance to regulatory standards as long as sampling documents its adequacy. Results for VOC from hole water in Pen Branch wetlands and hyporheic zone stations were not significantly different for the two different analytical methods. Relative concentrations of the different VOC's, PCE, TCE, DCE, and VC were similar for both GC/MS methods at the
different stations. Similar trends in de-creasing VOC concentrations at downstream Pen Branch stations were presented by both methods.

Subproject Title#3: Analyze Fission Product from Nuclear Processes and Technology

Principal Investigator: Dr. Joe Emily

Name of Conference	Location of Conference	Date of Conference	Conference Sponsor
United States Department of Energy Grantee Conference	Benedict College Columbia, SC	November 21, 2011	The Triangle Association of College
DOE-EM/HBCU Conference	South Carolina State University (SCSU)	April 11, 2012	South Carolina State University
SRNL-PARTNERING	SRNL Aiken, SC	January 31, 2013	SRNL-DOE
Partnering for Synergy and Success 2014 Research Collaboration Workshop and Poster Session	SRNL Aiken, SC	April 24, 2014	SRNL-DOE

SRNL-PARTNERING
Location: Savannah River National Laboratory, Aiken, SC Date:
January 31, 2013
Sponsor: DOE-EM and Savannah River National Laboratory

SCSU DOE-EM scholar presenting her findings on the movement of trace elements in the Edisto River Water Basin using the Agilent 7700 ICPMS located in the BASL facility.
Ms. JoEttie Clinton presented her findings concerning the movement of EPA RCRA elements through the Edisto River Watershed at a recent poster presentation on January 31, 2013 at the SRNL Hydrogen Research Center.

SRNL-PARTNERING FOR SYNERGY AND SUCCESS: 2014 RESEARCH COLLABORATION WORKSHOP & POSTER SESSION
Location: Savannah River National Laboratory, Aiken, SC Date:
Date: April 24, 2014
Sponsor: DOE-EM and Savannah River National Laboratory

Subproject Title#4: The expansion of the Analytical National Testing and Research Center for Hazardous Material Transportation Safety

Co- Principal Investigator: Dr. Judith Mwakalonge

&

Co- Principal Investigator: Dr. Reinhart Brown

Name of Conference	Location of Conference	Date of Conference	Conference Sponsor
United States Department of Energy Grantee Conference	Benedict College Columbia, SC	November 21, 2011	The Triangle Association of College
SRNL-PARTNERING	SRNL Aiken, SC	January 31, 2013	SRNL-DOE

Subproject Title#5: Radiochemistry/Health Physics/Nuclear Engineering

Principal Investigator: Dr. Stanley Ihekweazu

Name of Conference	Location of Conference	Date of Conference	Conference Sponsor
United States Department of Energy Grantee Conference	Benedict College Columbia, SC	November 21, 2011	The Triangle Association of College
SRNL-PARTNERING	SRNL Aiken, SC	January 31, 2013	SRNL-DOE

Subproject Title#6: Improved Environmental Management and Computational Sciences Project at SC State University

Principal Investigator: Dr. Stanley Ihekweazu

Name of Conference	Location of Conference	Date of Conference	Conference Sponsor
United States Department of Energy Grantee Conference	Benedict College Columbia, SC	November 21, 2011	The Triangle Association of College
SRNL-PARTNERING	SRNL Aiken, SC	January 31, 2013	SRNL-DOE

Subproject Title#7: Savannah River Environmental Sciences Field Station collaboration with SRS

Principal Investigator: Dr. Stanley Ihekweazu

Name of Conference	Location of Conference	Date of Conference	Conference Sponsor
United States Department of Energy Grantee Conference	Benedict College Columbia, SC	November 21, 2011	The Triangle Association of College
SRNL-PARTNERING	SRNL Aiken, SC	January 31, 2013	SRNL-DOE