NRC FORM 313 (7-96) 10 CFR 30, 32, 33 34, 35, 36, 39 and 40

U. S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0120 EXPIRES: 7/31/99

Estimated burden per response to comply with this information collection request: 7 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Forward comments regarding burden estimate to the Information and Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0120), Office of Management and Budget, Washington, DC 20503. NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION
NUCLEAR MATERIALS SAFETY BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION II
101 MARIETTA STREET, NW, SUITE 2900
ATLANTA, GA 30323-0199

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
801 WARRENVILLE RD.
LISLE, IL 60532-4351

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-8064

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S.NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*
   - [X] A. NEW LICENSE
   - [ ] B. AMENDMENT TO LICENSE NUMBER ______
   - [ ] C. RENEWAL OF LICENSE NUMBER ______

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip code)*
   USGS, Water Resources Division
   Stephenson Center, Suite 129
   720 Gracern Road
   Columbia, SC 29210-7651

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED
   U.S. Department of the Interior
   U.S. Geological Survey, Water Resources Division
   Stephenson Center, Suite 129
   720 Gracern Road
   Columbia, SC 29210-7651

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION
   Dr. Francis H. Chapelle
   Radiation Safety Officer (RSO)
   TELEPHONE NUMBER
   (803) 750-6116

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL.
   a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.
6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.
7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.
8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.
9. FACILITIES AND EQUIPMENT.
10. RADIATION SAFETY PROGRAM.
11. WASTE MANAGEMENT.
12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
    FEE CATEGORY Exempt 3P — AMOUNT ENCLOSED $ 0.00
13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

    THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

    WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER – TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
Glenn G. Patterson, District Chief	Glenn G. Patterson	10-22-96

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		257241
APPROVED BY				DATE	NMSS/RGNI MATERIALS-002

 PRINTED ON RECYCLED PAPER

ITEM 5

RADIOACTIVE MATERIAL

Element/Mass Number	Chemical and/or Physical Form	Maximum Amount That Licensee May Possess at Any One Time
A. Carbon 14	Any	50 millicuries
B. Nickel 63	Sealed or plated sources	30 millicuries

Authorized Use:

A. For use in laboratory tracer studies and molecular biology procedures (carbon-14)

B. For use in gas chromatographs for sample analysis

237241

ITEM 6

Purpose(s) for which licensed material will be used:

- Carbon-14 will be used in laboratory tracer studies and molecular biology procedures
- Nickel 63 - sample analysis in gas chromatographs

ITEM 7

Individuals responsible for Radiation Safety Program and material usage:

- Radiation Safety Officer (RS0), Dr. Francis H. Chapelle
- Assistant Radiation Safety Officer, Dr. Paul M. Bradley

Their formal training and experience resumes are attached (Enclosures B and C).

Authorized users under this materials license will be as follows:

- Dr. F. Chapelle RSO - For materials listed in Items A and B.
- Dr. P. Bradley Assistant RSO - For materials listed in Items A and B.
- Dr. D. Vroblesky - Principal Investigator - For materials listed in Items A and B.
- Dr. J. Landmeyer - Principal Investigator - For materials listed in Items A and B.

ITEM 8

TRAINING

1.0 PURPOSE

The purpose of this procedure is to determine the training requirements, training frequency, and individuals affected by the Training Program.

2.0 APPLICABILITY

This procedure applies to those individuals responsible for determining personnel affected, for scheduling training, and for those individuals responsible for conducting and monitoring the Training Program.

3.0 DEFINITIONS

3.1 USGS - United States Geological Service - Water Resources Division

3.2 RSO - Radiation Safety Officer

3.3 Restricted Area - Any area access to which is controlled for the purpose of protection of individuals from exposure to radiation and radioactive material.

4.0 RESPONSIBILITIES AND AUTHORITIES

4.1 The Radiation Safety Officer (RSO) has the responsibility to ensure that all individuals whose duties require them to work in the vicinity of radioactive material are properly instructed as required by paragraph 19.12 of 10 CFR 19.

4.2 Laboratory Supervisors have the responsibility to ensure that all individuals working in his/her lab have sufficient instruction or on-the-job training to perform their duties with or near radioactive material in a safe manner.

4.3 The Radiation Safety Officer has the authority to require any individual or group of individuals to attend refresher training in Radiation Safety practices if in his/her opinion that individual or group of individuals demonstrates a lack of knowledge in Radiation Safety practices. This refresher training may be in addition to the annual training requirements.

5.0 REQUIREMENTS AND INSTRUCTIONS

5.1 The Training Program shall include, but is not limited to, the requirements as outlined in paragraph 19.12 of 10 CFR 19 and in 10 CFR 20.

5.2 The Training Program shall be conducted:

a) Initially when an individual first enters the USGS work staff.

b) Annually as a refresher class.

c) As deemed necessary by the RSO.

5.3 All individuals who work with or near radioactive materials are required to attend the training classes as outlined above. This shall include those individuals such as security and housekeeping staff who must enter any portion of a Restricted Area in the performance of their job.

5.4 The training class should address items as found in the attached class outline, or other similar guide.

6.0 RECORDS

6.1 A record of those who attended training classes shall be documented using the Attendance Record of Training form.

6.2 Records of training shall be retained.

7.0 REFERENCES

7.1 10 CFR 19

7.2 10 CFR 20

7.3 NBS Handbook 92

7.4 NCRP Report No. 39

7.5 NCRP Report No. 48

7.6 USGS Radiation Safety Manual

8.0 ATTACHMENTS

8.1 Training Class Outline for Radiation Workers

8.2 Training Class Outline for Ancillary (Support) Workers

CLASS OUTLINE FOR RADIATION WORKERS

I. Introduction

A. Purpose of training

1. To fulfill regulatory requirements.
2. To familiarize workers with standards for protection.

B. References

1. 10 CFR 19
2. 10 CFR 20
3. NBS Handbook 92
4. NCRP Reports No 39 and 48
5. USGS Radiation Safety Manual

II. Principles of Radiation Protection

A. Philosophy of radiation exposure control

1. Radiation exposure control.
2. Radioactive material control.

B. Regulations and recommendations

C. Physical safeguards

D. The ALARA concept.

III. Radioisotope Laboratory Safety Procedures

A. Isotope receipt and inspection.

B. Radiation Caution signs and labels.

C. Anti-contamination practices.

D. Radioactive waste disposal.

E. Personnel monitoring.

F. Radiation emergency procedures.

IV. Radiation Protection Surveys

   A. Criteria and frequency.

   B. Measurement of radiation levels.

   C. Reviews and audits.

V. Question and Answer Time

CLASS OUTLINE FOR ANCILLARY (SUPPORT) WORKERS

I. Introduction

A. Purpose of training

1. To fulfill regulatory requirements.
2. To familiarize workers with standards for protection.

B. References

1. 10 CFR 19
2. 10 CFR 20
3. NBS Handbook 92
4. NCRP Reports No 39 and 48
5. USGS Radiation Safety Manual

II. Principles of Radiation Protection

A. Philosophy of radiation exposure control

1. Radiation exposure control.
2. Radioactive material control.

B. Regulations and recommendations

C. Physical safeguards

D. The ALARA concept

III. Question and Answer Time

RADIATION TRAINING SIGN-IN SHEET

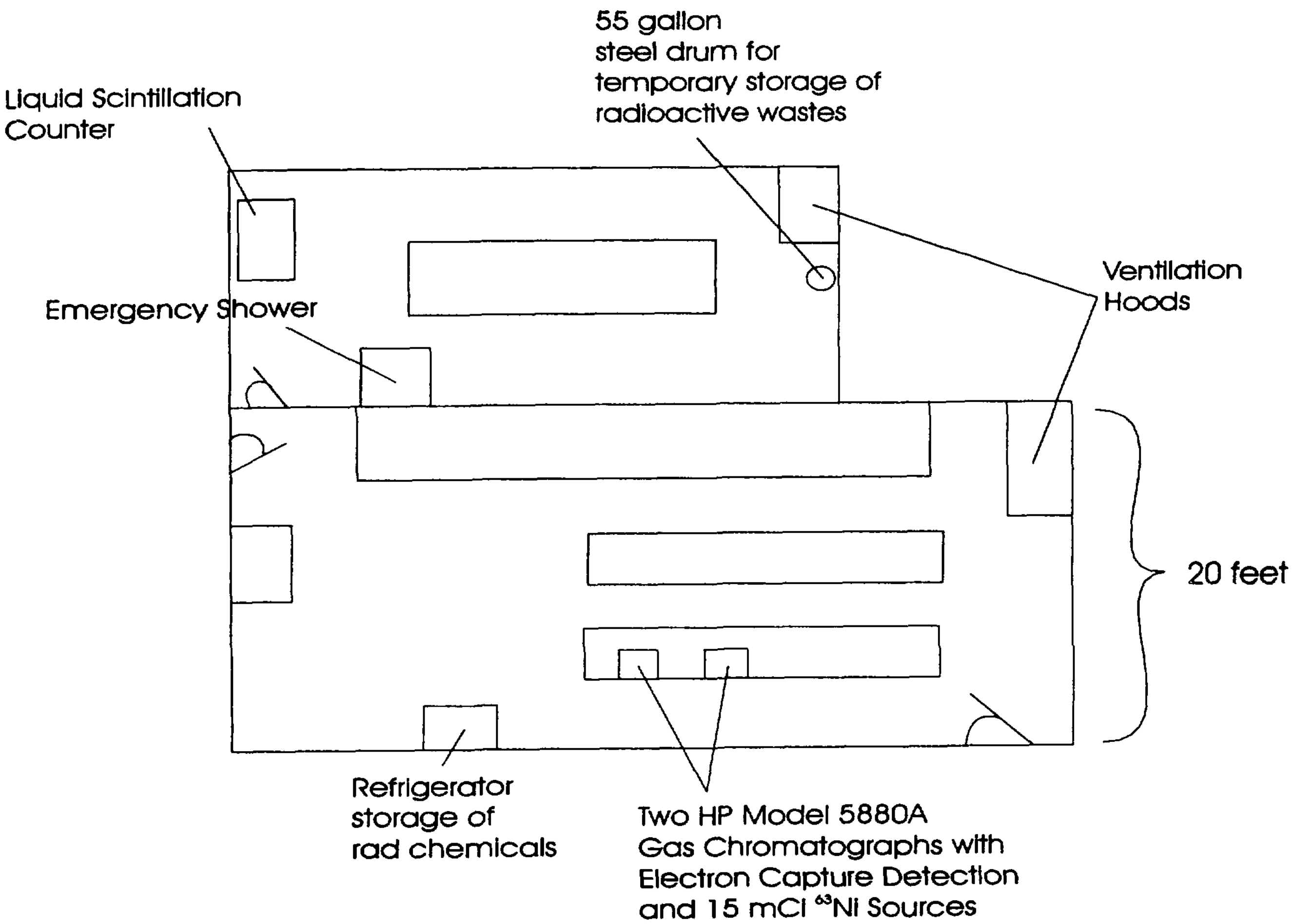
DATE: __________ *CLASS:* ______________________

Print Name	Signature	SSN

ITEM 9

FACILITIES AND EQUIPMENT

A diagram of the facilities and areas of use is given below:



Storage of radioactive waste prior to disposal will be in the 55-gallon steel drum. Radiation measurement instruments capable of detecting beta radiation are available for monitoring purposes. We have the following instuments available:

a. Ludlum Model 3 Survey Meter with Model 44-9 pancake GM detector, 0-50 kc/s..

b. Packard Model 1600TR Liquid scintillation Analyzer.

ITEM 10

RADIATION SAFETY PROGRAM

At the present time the Water Resources Division is identified on the USGS Materials License #45-15923-01 as amended with an expiration date of November 30, 2000. A formal documented Radiation Safety Manual has been prepared for this license.

It is the intent of the Water Resources Division to document and develop a formal Radiation Safety Manual for the facility located at Columbia, South Carolina commensurate with the license and Radiation Safety Program.

ITEM 11

RADIOACTIVE WASTE DISPOSAL

1.0 PURPOSE

This procedure establishes methods for disposing of radioactive waste.

2.0 APPLICABILITY

This procedure applies to all areas in which radioactive waste is generated.

3.0 DEFINITIONS

3.1 RSO - Radiation Safety Officer

4.0 RESPONSIBILITIES AND AUTHORITIES

4.1 Each individual is responsible to ensure that radioactive material is disposed of properly.

4.2 Laboratory Supervisor/Authorized User is responsible to ensure that radioactive material in his/her area is disposed of properly.

4.3 The RSO is responsible to ensure that this procedure is adequate and complies with applicable regulations.

5.0 REQUIREMENTS AND INSTRUCTIONS

5.1 Sanitary Sewerage System

Radioactive material may be disposed of through the Sanitary Sewerage System in compliance with 10 CFR Part 20, et al., Standards for Protection Against Radiation, Final Rule, May 21, 1991, Section 20.2003 Disposal by release into sanitary sewerage.

5.2 Wast Management and Disposal

The amountof Low-Level Radiation Waste (LLRW) generated at the Columbia, South Carolina facility is extremely small and minimal. All waste generated will be stored in a secure designated area until pick-up. Pick-up, transportation and disposal of LLRW will be handled by a broker, namely the U.S. Army, and disposed of at Branswell, South Carolina.

WASTE INVENTORY

RECORD OF CONTENTS

STORAGE AWAITING DISPOSAL FOR C14
FORM:________________________

NAME	DATE	ACTIVITY

257241

ENCLOSURE B

TRAINING AND EXPEREINCE

OF

RADIATION SAFETY OFFICER

CURRICULUM VITAE

NAME: Francis H. Chapelle

LOCATION: U.S. Geological Survey, Columbia, South Carolina

EDUCATION:	The George Washington University, Ph.D. 2/84 Hydrogeology/Geochemistry/Sedimentology The George Washington University, M.S. 3/79 Geology The University of Maryland, B.S. 6/76 Geology The University of Maryland, B.A. 6/74 Music
PROFESSIONAL SOCIETIES:	American Geophysical Union National Ground Water Association *Associate Editor,* Ground Water American Society for Microbiology Geological Society of America *Meinzer Award Committee, 1994-97*
AWARDS AND HONORS:	*National Award for Environmental Sustainability*, given by the nationally-recognized environmental advocacy group **Renew America**, Washington D.C., 1996. *National Ground Water Association Excellence in Science and Engineering Award*, 1993 USGS Special Achievement Awards, 1981, 84, 92, 95 USGS Superior Service Award, 1989 The George Washington University *Geza Teleki Award in Geology*, 1984.
PROFESSIONAL EXPERIENCE:	1979-85. U.S. Geological Survey, WRD, Towson, Maryland. Conducted ground-water flow, chemistry, and solute-transport studies of coastal plain aquifer systems. 1985-present. U.S. Geological Survey, Columbia, SC. Conducted studies on the effects of microorganisms on ground-water chemistry in pristine and contaminated
aquifer	systems.
SIGNIFICANT PUBLICATIONS:	Author of textbook entitled ***Ground-Water Microbiology and Geochemistry*** published by John Wiley & Sons. This textbook is used to teach microbial geochemistry in Universities throughout North America and Europe.

BIBLIOGRAPHY

PUBLISHED REPORTS

Chapelle, F.H. 1980, A proposed model for predicting trace metal composition of fly ash leachates. Environmental Geology 3:117-122.

Chapelle, F.H., 1983, Groundwater geochemistry and calcite cementation of the Aquia aquifer in southern Maryland. Water Resources Research, 19:545-558.

Chapelle, F.H. and D.D. Drummond, 1983, Hydrogeology, digital simulation, and geochemistry of the Aquia and Piney Point-Nanjemaoy aquifer system in southern Maryland. Maryland Geological Survey Report of Investigations no. 38, 100 pp.

Chapelle, F.H. and L.L. Knobel, 1983, Aqueous geochemistry and the exchangeable cation composition of glauconite in the Aquia aquifer, Maryland. Ground Water 21: 43-352.

Chapelle, F.H., 1984, The occurrence of dissolved oxygen and the origin of ferric hydroxide-cemented hardbeds in the Patuxent aquifer, Maryland. Proceedings, First Canadian/American Conference on Hydrogeology: Practical Applications of Ground-Water Geochemistry, June 22-26, Banff, Canada, National Water Well Association, Worthington, Ohio.

Chapelle, F.H. and T.M. Kean, 1985, Hydrogeology, digital solute-transport simulation, and geochemistry of the Lower Cretaceous aquifer system near Baltimore, Maryland. Maryland Geological Survey Report of Investigations no. 43, 120 pp.

Chapelle, F.H., 1986, A solute-transport simulation of brackish-water intrusion near Baltimore, Maryland. Ground Water, 24:304-311.

Knobel, L.L. and F.H. Chapelle, 1986, Northern Atlantic Coastal Plain Regional Aquifer Study: Geochemistry. Regional Aquifer-System Analysis Program of the U.S. Geological Survey Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, p. 186-190.

Chapelle, F.H. 1987, The role of understanding geochemical processes in hazardous waste studies. in Papers presented at the Toxic Waste Technical Meeting, Tucson, Arizona, March 20-22, 1984, U.S. Geological Survey Open-File Report 86-324.

Chapelle, F.H., Zelibor, J.L. Jr., Grimes, D.J., and Knobel, L.L., 1987, Bacteria in cored coastal plain sediments of Maryland: A possible source of CO_2 to ground water, Water Resources Research, 23:1625-1632.

Morris, J.T., Whiting, G.J. and Chapelle, F.H., 1988, Potential Denitrification Rates in Deep Sediments from the Southeastern coastal plain: Environmental Science and Technology, 22:832-836.

Chapelle, F.H., Morris, J.T., McMahon, P.B., and Zelibor, Jr., 1988, Bacterial metabolism and the δ^{13} C composition of ground water, Floridan aquifer system, South Carolina: Geology, 16:117-121.

Chapelle, F.H., and Morris, J.T., 1988, Potential for in situ biodegradation of JP-4 jet fuel at the defense fuel supply point, Charleston, South Carolina: U.S. Geological Survey Administrative Report, 20 pp.

Chapelle, F.H., McMahon, P.B., Lovley, D.R., Morris, J.T. 1988, Some impacts of bacterial metabolism on the ground-water geochemistry of deep coastal plain aquifers: Proceedings of the Ground-Water Geochemistry Conference, February 16-18, Denver, Colorado. National Water Well Association p. 153-174.

Lovley, D.R., F.H. Chapelle, and E.J.P. Phillips, 1990, Fe(III)-reducing bacteria in deeply buried sediments of the Atlantic Coastal plain, Geology, 18:954-957.

Chapelle, F.H. and D.R. Lovley, 1990, Rates of microbial metabolism in deep coastal plain aquifers. Applied and Environmental Microbiology, 56:1865-1874.

McMahon, P.B. and F.H. Chapelle, 1991, Microbial production of organic acids in aquitard sediments and its role in aquifer geochemistry. Nature, 349:233-235.

Chapelle, F.H. and P.B. McMahon, 1991, Geochemistry of dissolved inorganic carbon in a coastal plain aquifer: 1. Sulfate from confining beds as an oxidant in microbial CO_2 production. Journal of Hydrology 127:85-108.

McMahon, P.B., and F.H. Chapelle, 1991, Geochemistry of dissolved inorganic carbon in a coastal plain aquifer: 2. Modeling carbon sources, sinks, and δ^{13}-C composition. Journal of Hydrology 127:109-135.

McMahon, P.B., F.H. Chapelle, W.F. Falls, and P.M. Bradley, 1992, Role of microbial processes in linking sandstone diagenesis with organic-rich clays. Journal of Sedimentary Petrography 62:1-10.

Chapelle, F.H. and D.R. Lovley, 1992, Competative exclusion of sulfate reduction by Fe(III)-reducing bacteria: A mechanism for producing discrete zones of high-iron ground water, Ground Water 30:29-36.

McMahon, P.B., F.H. Chapelle, and M.L. Jagucki, 1992, Atrazine mineralization potential of allubial-aquifer sediments under aerobic conditions, Environmental Science and Technology 26(8):1556-1559.

Bradley, P.M., M. Fernandez, Jr., and F.H. Chapelle, 1992, Carbon limitation of denitrification rates in an anaerobic ground-water system, Environmental Science and Technology 26(12):2377-2381.

Chapelle, F.H., 1993, Ground-Water Microbiology and Geochemistry, New York, John Wiley and Sons, 448 pp.

Chapelle, F.H., P.M. Bradley, and P.B. McMahon, 1993, Subsurface Microbiology, in W.M. Alley (ed.) Regional Ground-Water Quality, NewYork, Van Nostrand Reinhold, p. 181-198.

Landmeyer, J.E., P.M. Bradley, and F.H. Chapelle, 1993, Influence of Pb on microbial activity in Pb-contaminated soils. Soil Biology and Biochemistry 25:1465-1466.

Bradley, P.M., F.H. Chapelle, M.L. Jagucki, and P.B. McMahon, 1994, Effect of atrazine on potential denitrification in aquifer sediments, Soil Biology and Biochemistry 26:523-524.

Lovley, D.R., J.C. Woodward, and F.H. Chapelle, 1994, Stimulated anoxic biodegradation of aromatic hydrocarbons using Fe(III) ligands, Nature 370:128-131.

Vroblesky, D.A. and F.H. Chapelle, 1994, Temporal and spatial changes of terminal electron-accepting processes in a petroleum hydrocarbon-contaminated aquifer and the significance for contaminant biodegradation, Water Resources Research 30:1561-1570.

Lovley, D.R., F.H. Chapelle, and J.C. Woodward, 1994, Use of H_2 concentrations to determine distribution of microbially catalyzed redox reactions in anoxic ground water, Environmental Science and Technology 28:1205-1210.

Bradley, P.M., F.H. Chapelle, J.E. Landmeyer, and J.G. Schumacher, 1994, Microbial transformation of nitroaromatics in surface soils and aquifer materials, Applied and Environmental Technology 60:2170-2175.

Bradley, P.M., F.H. Chapelle and M. Fernandez. 1992. Carbon limitation of denitrification in an anaerobic ground water system: implications for application rates of nitrogen fertilizer. Environmental Science and Technology. 26:2377-2381.

Bradley, P.M. and F.H. Chapelle. 1993. Arsenate inhibition of denitrification in nitrate contaminated sediments. Soil Biology and Biochemistry. 25:1459-1462.

Chapelle, F.H., P.M. Bradley and J.E. Landmeyer. 1993. Corrective action plan, naval exchange service station, Naval Air Station, Memphis, Millington, Tennessee. US Geological Survey Administrative Report 52pp.

Bradley, P.M., F.H. Chapelle and D.A. Vroblesky. 1994. Effects of Pb and terminal-electron-accepting processes on organic acid concentrations in contaminated aquifer sediments. D. W. Morganwalp and D.A. Aronson. eds. U.S. Geological Survey Toxic Substances Hydrology Program-- Proceedings of the Technical Meeting, Colorado Springs, Colorado, September 20-24, 1993: U.S. Geological Survey Water Resources Investigations Report 94-4014.

Chapelle, F.H. and P.M. Bradley. 1994.Microbial degradation of nitrotoluenes in surface soils and aquifer sediments, Weldon Spring, Missouri. D. W. Morganwalp and D.A. Aronson. eds. U.S. Geological Survey Toxic Substances Hydrology Program-- Proceedings of the Technical Meeting, Colorado Springs, Colorado, September 20-24, 1993: U.S. Geological Survey Water Resources Investigations Report 94-4014.

Bradley, P.M. and F.H. Chapelle. 1994. Microbial ecology of TNT and DNT in contaminated soils and aquifer materials at Weldon Spring, Missouri. Proceedings of the 2nd International Conference on Ground Water Ecology. Atlanta, Georgia, March 27-30.

Landmeyer, J.E., F.H. Chapelle and P.M. Bradley. 1994. Microbial activity in saprolite: a possible mechanism for saprolite formation in the piedmont. Proceedings of the 2nd International Conference on Ground Water Ecology. Atlanta, Georgia, March 27-30. Laboratory Co-Investigator.

Bradley, P.M., F.H. Chapelle, and J.E. Landmeyer. 1994. Microbial degradation of nitroaromatic contaminants in aquifers and surface soils. Proceedings of the 18th Annual Army Environmental Research and Development Symposium. Williamsburg, Virginia, June 28-30.

Bradley, P.M., F.H. Chapelle, and D.A. Vroblesky, 1994, Does lead affect microbial metabolism in aquifer sediments under different terminal electron accepting conditions? Geomicrobiology Journal 11:85-94.

Chapelle, F.H., P.B. McMahon, N.M. Dubrovsky, R.F. Fujii, E.T. Oaksford, and D.A. Vroblesky, 1995, Deducing the distribution of terminal electron accepting processes in hydrologically diverse ground-water systems, Water Resources Research 31:359-371.

Lovley, D.R. and F.H. Chapelle, 1995, Deep subsurface microbial processes, Reviews of Geophysics, 33:365-381.

Bradley, P.M. and F.H. Chapelle. 1995. Factors affecting microbial TNT mineralization in contaminated soil. Environmental Science and Technology.29:802-806.

Bradley, P.M., F.H. Chapelle, and P.B. McMahon. 1995. Nitrate and carbon limitation of denitrification in bed sediments from a waste-effluent-contaminated stream. Water Resources Research.31:1063-1068.

McMahon, P.B., D.A. Vroblesky, P.M. Bradley, F.H. Chapelle, and C.D. Gullet. 1995. Evidence for enhanced mineral dissolution in organic acid-rich shallow ground water. Ground Water. 33:207-216. Carried out Laboratory investigations portion of study.

Bradley, P.M., F.H. Chapelle, and J.E. Landmeyer. 1995. Degradation of 2,4-DNT, 2,6-DNT and 2,4,6-TNT by indigenous aquifer microorganisms. pp 267-272. In Bioremediation of Recalcitrant Organics. R.E. Hinchee, D. B. Anderson, and R. E. Hoeppel (Eds). Battelle Press. Columbus, OH.

Bradley, P.M., F.H. Chapelle. 1995. Rapid Toluene Mineralization by Aquifer Microorganisms at Adak, Alaska: Implications for Intrinsic Bioremediation in Cold Environments. Environmental Science and Technology. 29:2778-2881.

Lovley, D.R., J.C. Woodward, and F.H. Chapelle, 1996, Rapid anaerobic benzene oxidation with a variety of chelated Fe(III) forms, Applied Environmental Microbiology 62:288-291.

Chapelle, F.H., J.E. Landmeyer, and P.M. Bradley. 1996. Assessment of intrinsic bioremediation of jet fuel contamination in a shallow aquifer, Beaufort, South Carolina. U.S. Geological Survey Water Resources Investigations Report. 95-4262. p. 30.

Landmeyer, J.E., D.A. Vroblesky, and F.H. Chapelle, 1996. Stable carbon isotope evidence of biodegradation zonation in a shallow jet-fuel contaminated aquifer. Environmental Science and Technology. 30:1120-1128.

Vroblesky, D.A., P.M. Bradley, and F.H. Chapelle. Influence of electron donor on the minimum sulfate concentration required for sulfate reduction in a petroleum hydrocarbon-contaminated aquifer. Environmental Science and Technology. 30:1377-1381.

REPORTS IN PRESS

Bradley, P.M. and F.H. Chapelle. Anaerobic mineralization of vinyl chloride in aquifer sediments. Environmental Science and Technology. In press.

Bradley, P.M., F.H. Chapelle, and J.E. Landmeyer. Mineralization of dinitrotoluenes by aquifer microorganisms. Ground Water. In press.

Landmeyer, J.E., F.H. Chapelle, and P.M. Bradley. Evaluation of intrinsic bioremediation as an option for remediating gasoline contamination, Laurel Bay Exchange, Marine Corps Air Station, Beaufort, South Carolina. U.S. Geological Survey Water Resources Investigations Report. In press.

Chapelle, F.H., P.M. Bradley, D.A. Vroblesky, and D.R. Lovley. Measuring rates of biodegradation in a petroleum hydrocarbon-contaminated aquifer. Ground Water 34:691-698.

Chapelle, F.H. and P.M. Bradley. Short-chain organic acids in confining bed porewater: implications for microbial carbon cycling in deep aquifer systems. Geology. In Press.

PUBLISHED ABSTRACTS (last year only)

Chapelle, F.H., P.M Bradley, and J.L. Landmeyer, 1995, Assessing the efficiency of intrinsic bioremediation. Third International In Situ and On-Site Bioreclamation Symposium, April 24-28, San Diego, CA.

Chapelle, F.H. 1995. Measuring rates of biodegradation in petroleum hydrocarbon-contaminated systems. American Society for Microbiology, Annual Meeting, May 22-26, Washington, D.C.

Chapelle, F.H. 1995. A Framework for assessing the efficiency of intrinsic bioremediation. International Association of Hydrogeologists, Edmonton, Alberta, June 5-9.

Chapelle, F.H. 1995. Measuring rates of biodegradation using field and laboratory methods. Inauguration of VEGAS research facility, Stuttgart, Germany, September 25-27.

Chapelle, F.H. 1995. Rates of biodegradation in contaminated ground-water systems. IBC Conference on Intrinsic Bioremediation, Annapolis, MD, October 16-17.

Chapelle, F.H. 1996. A Framework for Assessing the Efficiency of Intrinsic Bioremediation. The First International Conference on How to Use Intrinsic Bioremediation as a Reliable Tool for Clean-Up of Contaminated Ground @ Ground Water. London, England, March 18-19.

ADDITIONAL SCIENTIFIC CONTRIBUTIONS

LECTURES GIVEN AT UNIVERSITIES (Last year only)

Michigan State University, March 16-17, 1995

Strategies for Bioremediation

Methodology for determining TEAPs in ground-water systems

Measuring rates of biodegradation

University of Michigan, March 31, 1995

Methodology for determining TEAPs in ground-water systems

University of New Hampshire, February 5, 1995

The Fundamentals of Microbiology in Bioremediation

Clemson University, February 15, 1995

Strategies for Bioremediation

PAPERS PRESENTED AT SCIENTIFIC MEETINGS (Last year only)

Third International In Situ and On-Site Bioreclamation Symposium, San Diego, CA, April 24-28, 1995. Assessing the efficiency of intrinsic bioremediation.

Department of Defense Environmental Contamination Program, Albuquerque, NM, May 1-3, 1995. Framework for utilizing intrinsic bioremediation.

Annual Meeting, American Society for Microbiology, Washington, D.C., May 22-26. 1995. Measuring rates of biodegradation in petroleum hydrocarbon-contaminated systems.

International Association of Hydrogeologists, Edmonton, Alberta, June 5-9, 1995. A Framework for assessing the efficiency of intrinsic bioremediation

Inauguration of VEGAS research facility, Stuttgart, Germany, September 25-27. Measuring rates of biodegradation using field and laboratory methods.

IBC Conference on Intrinsic Bioremediation, Annapolis, MD, October 16-17. Rates of biodegradation in contaminated ground-water systems.

The First International Conference on How to Use Intrinsic Bioremediation as a Reliable Tool for Clean-Up of Contaminated Ground & Ground Water. London, England, March 18-19. A Framework for Assessing the Efficiency of Intrinsic Bioremediation.

TRAINING GIVEN AT USGS NATIONAL TRAINING CENTER

Incumbent acted as coordinator for course "Microbiology of Ground-Water Systems", given April 17-21, 1995.

PROFESSIONAL SOCIETY ASSIGNMENTS

Oscar Meinzer Award Selection Committee

OTHER COMMITTEE ASSIGNMENTS

WRD Scientific Advisory Committee

OTHER TALKS AND SEMINARS

Chief Hydrologist's Seminar, Reston, VA, February 14, 1996. Framework for Applying Intrinsic Bioremediation

OTHER ASSIGNMENTS

Member of the Clean Up Review Team (CURT) for the Naval Facilities Engineering Service Center (NFESC), responsible for formulating as Navy-wide policy for implementing intrinsic bioremediation.

AUTOBIOGRAPHY

1976 Received BS in geology from the University of Maryland. Started graduate school at The George Washington University.

1978 Received MS in geology from The George Washington University. Went to work for Roy F. Weston, Inc. as an Assistant Project Geologist.

1979 Came to the U.S. Geological Survey, WRD, in Towson, Maryland as a GS-9 Hydrologist. Became project leader of "Hydrogeology and geochemistry of the Aquia and Piney-Point aquifer system. This project developed a regional digital ground-water flow model and investigated cation exchange and calcite dissolution/precipitation processes in this hydrologic system.

1980 Promoted to GS-11

1981 Became project leader of "Ground-water Quality in the Baltimore Industrial Area". This project investigated the geochemistry of human-induced contamination of ground water, and constructed a digital solute-transport model of brackish water intrusion. Began Ph.D. program at The George Washington University.

1982 Promoted to GS-12

1984 Received Ph.D. degree and was awarded the Geza Teleki Award in Geology.

1985 Promoted to GS-13 under the Research Grade Evaluation Guide. Relocated to the South Carolina District and began a series of projects designed to elucidate the role of microorganisms in ground-water chemistry.

1988 Formed the Microbial Studies Group in the South Carolina District to promote the investigation of microbial processes in ground-water chemistry.

1989 Became Adjunct Professor of Geology at the University of South Carolina. Promoted to GS-14 under Research Grade Evaluation Guide.

1990 Initiated a series of projects, funded by DOD, to evaluate the effectiveness of intrinsic and engineered bioremediation.

1993 Published textbook Ground Water Microbiology and Geochemistry, John Wiley & Sons. Promoted to GS-15 in the RGE.

1995 Completed and published framework for assessing the efficiency of intrinsic bioremediation.

ENCLOSURE C

TRAINING AND EXPEREINCE

OF

RADIATION SAFETY OFFICER

PAUL MICAH BRADLEY

CURRICULUM VITAE

PERSONAL

United States Geological Survey
Water Resources Division
Stephenson Center, Suite 129
720 Gracern Road
Columbia, SC 29210-7651
(803) 750-6125

Born:

EDUCATION

B.S. School of Applied Biology (June 1984)
Georgia Institute of Technology

M.S. School of Applied Biology (June 1987)
Georgia Institute of Technology
Thesis: Effects of Sulfide on Growth and Metabolic Responses of Salt Marsh Halophytes of the Southeastern United States

Ph.D. Marine Science Program (May 1991)
University of South Carolina
Dissertation: Effects of Edaphic Factors on the Physiological Ecology of the Salt Marsh Cord Grass, *Spartina alterniflora* Loisel.

PROFESSIONAL EXPERIENCE

Present

Hydrologist, GS-13, Water Resources Division, United States Geological Survey, Columbia, SC (Since 10-1994)

Adjunct Assistant Professor, Department of Biological Sciences, University of South Carolina, Columbia, SC 29208 (Since 07-1991)

Past

1993-1994 Hydrologist, GS-12, Water Resources Division, United States Geological Survey, Columbia, SC

257241

1991-1993	Hydrologist, GS-11, Water Resources Division, United States Geological Survey, Columbia, SC
1988-1991	Student Appointment, Hydrologist, Water Resources Division, United States Geological Survey, Columbia, SC
1987-1988	Graduate Teaching Assistant, Marine Science Program, University of South Carolina, Columbia, SC
1986-1987	Graduate Teaching Assistant, School of Applied Biology, Georgia Institute of Technology, Atlanta, GA
1984-1986	Graduate Research Assistant, School of Applied Biology, Georgia Institute of Technology, Atlanta, GA
1984-1985	Research Assistant, University of Georgia Marine Institute, Sapelo Island, GA
1982-1984	Laboratory Technician, School of Applied Biology, Georgia Institute of Technology, Atlanta, GA

TEACHING EXPERIENCE

1985	Plant and Animal Physiology Lab, GIT Introductory Biology Lab, GIT Limnology Lab, GIT
1986	Introductory Biology Lab, GIT Field Ecology, GIT
1987	Introductory Biology Lab, GIT Marine Science 101 Lab, USC
1988	Marine Science 102 Lab, USC
1993	Microbial Geochemistry of Hydrologic Systems (G0512), USGS-WRD
1994	Ground-Water Microbiology Workshop, USGS-WRD
1995	Microbial Geochemistry of Hydrologic Systems (G0512), USGS-WRD

SOCIETIES

American Chemical Society
American Society of Microbiology
Sigma Xi

AWARDS/HONORS

1986	Summer Research Fellowship, University of Georgia Marine Institute, Sapelo Island, Georgia
1988	Sigma Xi Masters Thesis Award, Georgia Institute of Technology
1988-1991	Slocum-Lunz Foundation Fellowship, Slocum-Lunz Foundation, Charleston, SC
1990	Best Student Paper Award, Ecological Section, Botanical Society of America, Richmond, VA

	US Geological Survey Special Achievement Award
1991	Sigma Xi Graduate Career Award, University of South Carolina
1993	Quality Increase, USGS-WRD
1994	Quality Increase, USGS-WRD
1995	Quality Increase, USGS-WRD
1996	National Award for Envionmental Sustainability, 6th Annual Renew America Awards Ceremony

PRESENTATIONS

1987 Georgia Institute of Technology, Atlanta, Georgia.
Effects of Sulfide on Growth and Metabolic Responses of Salt Marsh Halophytes of the Southeastern United States.

University of Georgia Marine Institute, Sapelo Island, Georgia.
Effects of sulfide on the growth of three species of salt marsh halophytes.

1988 Southeastern Estuarine Research Society, Jacksonville, Florida.
Effects of soluble sulfide on ammonium uptake in Spartina alterniflora.

1989 American Institute of Biological Sciences, Toronto, Ontario, Canada.
Influence of anoxia and sulfide concentration on the nitrogen uptake kinetics of Spartina alterniflora in solution culture.

1990 American Society of Limnology and Oceanography, Williamsburg, Virginia.
The ecological implications of physical characteristics of salt marsh sediments.

American Institute of Biological Sciences, Richmond, Virginia.
Effects of salinity on the kinetics of NH_4^+ uptake in Spartina alterniflora.

1991 University of South Carolina, Columbia, South Carolina.
Effects of Edaphic Factors on the Physiological Ecology of the Salt Marsh Cord Grass, Spartina alterniflora Loisel.

1993 USGS-Toxics Substances Hydrology Program, Colorado Springs, Colorado.
Effects of Pb and terminal-electron-accepting processes on organic acid concentrations in contaminated aquifer sediments.

USGS-Toxics Substances Hydrology Program, Colorado Springs, Colorado.
Microbial degradation of nitrotoluenes in surface soils and aquifer sediments, Weldon Spring, Missouri.

1994 2nd International Conference on Ground Water Ecology, Atlanta, Georgia.

Microbial ecology of TNT and DNT in contaminated soils and aquifer materials at Weldon Spring, Missouri.

1995 Third International Symposium on In Situ and On-Site Bioreclamation. San Diego, California. Degradation of explosives compounds by aquifer microorganims. (Invited Speaker).

American Society for Microbiology. Washington, D.C. Environmental factors affecting mineralization of TNT by microorganisms indigenous to explosives contaminated soil.

Special Symposium on Emerging Technologies in Hazardous Waste Management VII. American Chemical Society. Atlanta, Georgia. Factors affecting 2,4,6-trinitrotoluene degradation in contaminated soil. (Invited Speaker).

IBC's International Symposium on Intrinsic Bioremediation: Strategies for Effective Analysis, Monitoring and Implementation. Anapolis, Maryland. Potential for intrinsic bioremediation of explosives-contaminated ground water. (Invited Speaker).

PUBLICATIONS

1987 THESIS: Effects of Sulfide on Growth and Metabolic Responses of Salt Marsh Halophytes of the Southeastern United States. Georgia Institute of Technology. School of Applied Biology. 116 p.

1989 Bradley, P.M. and E.L. Dunn. Effects of sulfide on the growth of three salt marsh halophytes of the southeastern United States. American Journal of Botany 76(12):1707-1713.

1990 Bradley, P.M. and J.T. Morris. Influence of oxygen and sulfide concentration on nitrogen uptake kinetics in Spartina alterniflora. Ecology 71(1):282-287.

Bradley, P.M. and J.T. Morris. Physical characteristics of salt marsh sediments: ecological implications. Marine Ecology Progress Series 61:245-252.

Bradley, P.M., B. Kjerfve and J.T. Morris. Rediversion salinity change in Cooper River, South Carolina: ecological implications. Estuaries. 13(4):373-379.

1991 Bradley, P.M. and J.T. Morris. Influence of salinity on the kinetics of NH_4^+ uptake in Spartina alterniflora. Oecologia. 85:375-380.

Aelion, C.M. and P.M. Bradley. Aerobic biodegradation potential of subsurface microorganisms from a jet fuel contaminated aquifer. Applied and Environmental Microbiology. 57(1):57-63.

DISSERTATION: Effects of Edaphic Factors on the Physiological Ecology of the Salt Marsh Cord Grass, Spartina alterniflora Loisel. University of South Carolina. Marine Science Program. 200 p.

Bradley, P.M. and J.T. Morris. The relative importance of ion exclusion, secretion and accumulation in Spartina alterniflora Loisel. Journal of Experimental Botany. 42(245):1525-1532.

1992

McMahon, P.B., F.H. Chapelle, W.F. Falls, and P.M. Bradley. Role of microbial processes in linking sandstone diagenesis with organic-rich clays. Journal of Sediment Petrology. 62(1):1-10.

Bradley, P.M. and J.T. Morris. Nitrogen limitation of growth and the effect of salinity on the critical nitrogen content of Spartina alterniflora Loisel. Aquatic Botany. 43:149-161.

Bradley, P.M., C.M. Aelion and D.A. Vroblesky. Influence of environmental factors on denitrification in sediment contaminated with JP-4 jet fuel. Ground Water. 30(6):843-848.

Bradley, P.M., F.H. Chapelle and M. Fernandez. Carbon limitation of denitrification in an anaerobic ground water system: implications for application rates of nitrogen fertilizer. Environmental Science and Technology. 26(12):2377-2381.

1993

Chapelle, F.H., P.M. Bradley, and P.B. McMahon. Chapter 8. Subsurface Microbiology. pp. 181-198 in W.M. Alley (ed.) Regional Ground-Water Quality. Springer-Verlag, New York.

Bradley, P.M. and F.H. Chapelle. Arsenate inhibition of denitrification in nitrate contaminated sediments. Soil Biology and Biochemistry. 25(10):1459-1462.

Landmeyer, J.E., P.M. Bradley, and F.H. Chapelle. Influence of lead on microbial activity in lead-contaminated and -uncontaminated sediments. Soil Biology and Biochemistry. 25(10):1465-1466.

Chapelle, F.H., P.M. Bradley, and J.E. Landmeyer. Corrective action plan, naval exchange service station, Naval Air Station, Memphis, Millington, Tennessee. US Geological Survey Water Resources Investigation Report.

Fernandez, M., P.M. Bradley, and J.P. Spears. Investigation of the source and extent of high nitrate concentrations near the senior officers' housing area, MacDill Air Force Base, Florida. US Geological Survey Water Resources Investigation Report.

1994 Bradley, P.M., F.H. Chapelle, P.B. McMahon, and M. Jagucki. Influence of atrazine on potential denitrification in saturated sediments. Soil Biology and Biochemistry. 26(4):523-524.

Bradley, P.M., F.H. Chapelle, and D.A. Vroblesky. Effects of Pb and terminal-electron-accepting processes on organic acid concentrations in contaminated aquifer sediments. Proceedings US Geological Survey Toxic Substances Hydrology Program.

Chapelle, F.H. and P.M. Bradley. Microbial degradation of nitrotoluenes in surface soils and aquifer sediments, Weldon Spring, Missouri. Proceedings US Geological Survey Toxic Substances Hydrology Program.

Bradley, P.M., F.H. Chapelle, and D.A. Vroblesky. Does lead affect microbial metabolism in aquifer sediments under different terminal electron accepting conditions? Geomicrobiology. 11:85-94.

Bradley, P.M., F.H. Chapelle, J.E. Landmeyer, and J.G. Schumacher. Microbial transformation of nitroaromatics in surface soils and aquifer sediments. Applied and Environmental Microbiology. 60(6)2170-2175.

Bradley, P.M. and F.H. Chapelle. Microbial ecology of TNT and DNT in contaminated soils and aquifer materials at Weldon Spring, Missouri. Proceedings of the 2nd International Conference on Ground Water Ecology. Atlanta, Georgia, March 27-30.

Landmeyer, J.E., F.H. Chapelle and P.M. Bradley. Microbial activity in saprolite: a possible mechanism for saprolite formation in the piedmont. Proceedings of the 2nd International Conference on Ground Water Ecology. Atlanta, Georgia, March 27-30.

Bradley, P.M., F.H. Chapelle, and J.E. Landmeyer. Microbial degradation of nitroaromatic contaminants in aquifers and surface soils. Proceedings of the 18th Annual Army Environmental Research and Development Symposium. Williamsburg, Virginia, June 28-30.

1995 Bradley, P.M. and F.H. Chapelle. Factors affecting microbial TNT mineralization in contaminated soil. Environmental Science and Technology.29:802-806.

Bradley, P.M., F.H. Chapelle, and P.B. McMahon. Nitrate and carbon limitation of denitrification in bed sediments from a waste-effluent-contaminated stream. Water Resources Research.31:1063-1068.

McMahon, P.B., D.A. Vroblesky, P.M. Bradley, F.H. Chapelle, and C.D. Gullet. Evidence for enhanced mineral dissolution in organic acid-rich shallow ground water. Ground Water. 33:207-216.

Bradley, P.M., F.H. Chapelle, and J.E. Landmeyer. Degradation of 2,4-DNT, 2,6-DNT and 2,4,6-TNT by indigenous aquifer microorganisms. pp 267-272. In Bioremediation of Recalcitrant Organics. R.E. Hinchee, D. B. Anderson, and R. E. Hoeppel (Eds). Battelle Press. Columbus.

Bradley, P.M., F.H. Chapelle. Rapid Toluene Mineralization by Aquifer Microorganisms at Adak, Alaska: Implications for Intrinsic Bioremediation in Cold Environments. Environmental Science and Technology. 29:2778-2881.

1996 Chapelle, F.H., J.E. Landmeyer, and P.M. Bradley. Assessment of intrinsic bioremediation of jet fuel contamination in a shallow aquifer, Beaufort, South Carolina. U.S. Geological Survey Water Resources Investigations Report. 95-4262. p. 30.

Bradley, P.M. and F.H. Chapelle. Anaerobic mineralization of vinyl chloride in Fe(III)-Reducing, aquifer sediments. Environmental Science and Technology. 30:2084-2086.

Landmeyer, J.E., F.H. Chapelle, and P.M. Bradley. Evaluation of passive bioremediation as an option for remediating gasoline contamination, Laurel Bay Exchange, Marine Corps Air Station, Beaufort, South Carolina. U.S. Geological Survey Water Resources Investigations Report. 96-4026. p. 50.

Chapelle, F.H., P.M. Bradley, D. R. Lovley, and D.A. Vroblesky. Measuring rates of biodegradation in a petroleum hydrocarbon-contaminated aquifer. Ground Water. 34:691-698.

Vroblesky, D.A., P.M. Bradley, and F.H. Chapelle. Influence of electron donor on the minimum sulfate concentration required for sulfate reduction in a petroleum hydrocarbon-contaminated aquifer. Environmental Science and Technology. 30:1377-1381.

In Press Bradley, P.M., F.H. Chapelle, and J.E. Landmeyer. Mineralization of dinitrotoluenes by aquifer microorganisms. Ground Water.

257241

Chapelle, F.H., P.M. Bradley, and J.E. Landmeyer. Short-chain organic acids in confining bed porewater: implications for microbial carbon cycling in deep aquifer systems. Water Resources Research.

Submitted Bradley, P.M., F.H. Chapelle, and J.T. Wilson. Intrinsic biodegradation of vinyl chloride in an Fe(III)-reducing aquifer. Ground Water.

Vroblesky, D.A., P.M. Bradley, and F.H. Chapelle. The effects of carbon loading on accumulation of organic acids in a petroleum hydrocarbon-contaminated aquifer. Water Resources Research.

Chapelle, F.H., S.K. Haack, P. Adriaens, M.A. Henry, and P.M. Bradley. Comparison of Eh and H_2 measurements for delineating redox zonation in a contaminated aquifer. Environmental Science and Technology.

ABSTRACTS

1985 Dunn, E.L., P.M. Bradley, A.G. Chalmers, W.J. Wiebe, and R.G. Wiegert. Responses of Spartina alterniflora to natural and experimental gradients of salinity and sediment factors associated with soil water drainage. Bulletin of the Ecological Society of America 66:167.

1986 Dunn, E.L. and P.M. Bradley. Environmental factors affecting in situ primary productivity in low gradient coastal plain rivers in the southeastern U.S. Bulletin of the Ecological Society of America 67.

1988 Bradley, P.M. and E.L. Dunn. Effects of sulfide on growth of salt marsh halophytes of the Southeastern USA. Bulletin of the Ecological Society of America 69(2):80.

1989 Bradley, P.M. and J.T. Morris. Influence of anoxia and sulfide concentration on the nitrogen uptake kinetics of Spartina alterniflora in solution culture. American Journal of Botany 76(6):93.

Morris, J.T. and P.M. Bradley. Regulation of pore water salinity in intertidal sediments. Invited paper, Tenth Biennial International Estuarine Research Conference. Baltimore.

1990 Bradley, P.M. and J.T. Morris. The ecological implications of physical characteristics of salt marsh sediments. American Society of Limnology and Oceanography. 10.

Edwards, D., P.M. Bradley, J.T. Morris and D. Ruppert. Statistical analysis of the integrated Michaelis-Menten model. Bulletin of the Ecological Society of America 71(2):185.

Bradley, P.M. and J.T. Morris. Effects of salinity on the kinetics of NH_4^+ uptake in Spartina alterniflora. American Journal of Botany 77(6):50.

1993 Bradley, P.M., F.H. Chapelle, and D.A. Vroblesky. Effects of Pb and terminal-electron-accepting processes on organic acid concentrations in contaminated aquifer sediments. US Geological Survey Toxic Substances Hydrology Program.

Chapelle, F.H. and P.M. Bradley. Microbial degradation of nitrotoluenes in surface soils and aquifer sediments, Weldon Spring, Missouri. US Geological Survey Toxic Substances Hydrology Program.

Vroblesky, D.A., T.M. Yanosky, and P.M. Bradley. Signatures of ground water contamination in the inorganic chemistry of trees. Dendrochronology and Dendrochemistry in Forest Health and Monitoring. Penn State Univ.

1994 Bradley, P.M. and F.H. Chapelle. Microbial ecology of TNT and DNT in contaminated soils and aquifer materials at Weldon Spring, Missouri. Proceedings of the 2nd International Conference on Ground Water Ecology. Atlanta, Georgia, March 27-30.

Bradley, P.M., F.H. Chapelle, and J.E. Landmeyer. Microbial degradation of nitroaromatic contaminants in aquifers and surface soils. Proceedings of the 18th Annual Army Environmental Research and Development Symposium. Williamsburg, Virginia, June 28-30.

Landmeyer, J.E., F.H. Chapelle, and P.M. Bradley. Natural microbial remediation of contaminated ground water in Appalachian hydrologic systems. Proceeding of the Southern Appalachian Man and the Biosphere Conference. Hendersonville, North Carolina, November 14-17.

1995 Bradley, P.M., F.H. Chapelle, and J.E. Landmeyer. Microbial degradation of TNT and DNT at Weldon Spring, Missouri. Third Internation Symposium on In Situ and On-Site Bioreclamation. San Diego, California, April 24-27.

Bradley, P.M. and F.H. Chapelle. Environmental factors affecting mineralization of TNT by microorganisms indigenous to explosives contaminated soil. 95th General Meeting of the American Society for Microbiology. Washington, D.C., May 21-25.

Landmeyer, J.E., F.H. Chapelle, and P.M. Bradley. Hydrogeologic and microbiologic factors affecting intrinsic bioremediation of petroleum hydrocarbons in an island hydrologic system, South Carolina, USA. American Water Resources Association. Honolulu, Hawaii, June 25-28.

Bradley, P.M. and F.H. Chapelle. Factors affecting 2,4,6-trinitrotoluene degradation in contaminated soil. Special Symposium on Emerging Technologies in Hazardous Waste Management VII. American Chemical Society. Atlanta, Georgia. September 17-20.

Bradley, P.M. and F.H. Chapelle. Potential for intrinsic bioremediation of explosives-contaminated ground water. IBC's International Symposium on Intrinsic Bioremediation: Strategies for Effective Analysis, Monitoring and Implementation. Anapolis, Maryland. October 16-17.

ENCLOSURE D

RADIOACTIVE MATERIALS PROTOCOL

Radioactive Materials Protocol

Background.

During the course of microbiological investigations of subsurface systems it is frequently useful to determine whether a particular compound is metabolizable. For example, at sites which are contaminated by petroleum hydrocarbons, degradation of BTX (benzene, toluene, and xylene) compounds is commonly used as an indicator of the potential for microbial bioremediation of petroleum contamination. The biodegradability of a substrate can be assessed by following the disappearance of the substrate over time, but there are shortcomings to such an approach. From a bioremediation point of view, biodegradation of a compound is beneficial only if the products are less problematic than the original compound. Ideally a contaminant is completely mineralized to an innocuous compound such as CO_2. If non-tracer techniques are used, however, it is often difficult to demonstrate that the CO_2 released during a biodegradation study originates from a specific substrate.

In contrast, the use of radiolabeled substrates provides a powerful and sensitive technique for determining if a microbial community can mineralize a specific contaminant. Under most circumstances, the release of $^{14}CO_2$ during microbial degradation of a labeled substrate provides unequivocal evidence for substrate mineralization. In this document, ^{14}C-toluene will be used as a example compound to illustrate the use of radioactive substrates (^{14}C and ^{35}S isotopes) to evaluate the bioremediation potential of the subsurface microbial communities.

Method.

Microcosm Preparation. Place 2-5 g of moist sediment in each of 12 previously sterilized

[redacted]

serum vials. Stopper each vial with a stopper/base trap assembly and seal with aluminum crimp seals. A schematic of an assembled microcosm is provided in figure 3. Prepare abiological controls by autoclaving for 30 minutes at 121°C and 15 psi. After the controls have cooled to room temperature, add 1 mL of ^{14}C-toluene solution (approximately 100,000 dpm/mL) to each of the 12 vials (eight experimental and four control) and shake thoroughly to mix the label with the sediment. Allow the vials to incubate in the dark at room temperature. Immediately after the labeled solution has been added to microcosms place 1.0 mL of ^{14}C-toluene solution in a scintillation vial containing 15 mL of scintillation cocktail. The amount of radioactivity in these vials is equal to the total radioactivity added to the microcosms. Periodically, after the addition of radiolabeled toluene, sacrifice two experimental and one killed control vial. Vials are sacrificed by placing 0.3 mL of 10 N KOH in the suspended base trap and then adding 1 mL of 13 N H_3PO_4 directly to the sediment surface. Repeat this procedure at appropriate intervals. Let the sacrificed vials sit overnight in the dark.

On the following day, collect the $^{14}CO_2$ trapped in the KOH solution. Use a 1 mL syringe with needle to pierce the stopper and remove the KOH from the trap assembly. Dispense the trapping solution into a labeled scintillation vial containing 15 mL of scintillation cocktail. Quantify the radioactivity of the sample using a liquid scintillation counter. Express the amount of radioactivity trapped in the base as a percentage of the total radioactivity added to the microcosm.

Scintillation Counting. The most common laboratory method for quantifying radioactive substrates and endproducts is liquid scintillation counting. The samples to be counted should be placed in 15 mL of scintillation cocktail.

Waste Disposal. At the end of the mineralization study microcosm material should be disposed in the following manner. All activities should be carried out under the hood. Remove the stopper/base trap assemblies and dispose in radioactive solid waste bin. Allow microcosms to evaporate to dryness under the hood. When microcosms are completely dry, remove and dispose in radioactive solid waste bin. All gloves, needles, syringes and other experimental wastes should be dried under the hood and disposed in radioactive solid waste bin. Scintillation cocktail used during all microcosm experiments should be biodegradable, non-toxic solution, such as Packard Ultima Gold, suitable for disposal, with excess dilution, to sanitary sewer system. Scintillation vials should be rinsed with an excess of tap water and disposed of as nonradioactive solid waste. All empty manufacturer's containers and empty working-stock solution vials should be evaporated to dryness under the hood and disposed in the radioactive solid waste bin.

ENCLOSURE E

USGS

WATER RESOURCES DIVISION

TABLE OF ORGANIZATION

USGS SOUTH CAROLINA DISTRICT OFFICE, COLUMBIA, SC

Glenn G. Patterson, District Chief-14

ADMINISTRATIVE SERVICES SECTION

Kim S. Crutchfield, Administrative Officer-09
Vacant, Admin Oper Asst-07
N. Jo Ernst, Admin. Opr. Asst.-06
Natalie S. Rice, Administrative Clerk-05
Carolyn E. Reno, Office Auto Clerk-04
Vacant, Office Auto Clerk-04

COMPUTER SERVICES SECTION

Vacant, Computer Specialist-12
Margni I. Shealy, Computer Specialist-11 (Safety Officer)
Vacant, Computer Assistant-05

SANTEE-COASTAL NAWQA

William B. Hughes, Supv. Hydrologist-13
Terry L. Sicherman, Hydrologist-12
Whitney J. Stringfield, Hydrologist, GS-11
Thomas A. Abrahamsen, Biologist-11
Eric J. Reuber, Hydrologist-09
W. Boyce Blanks, Geographer-09
Donald E. Leary, Jr., Hydrologic Technician-08
Carlton D. Wood, Hydrologic Technician-09
Robert A. Thorn, Hydrologic Technician-06
Lance J. Wilhelm, Hydrologic Technician-06

EDITORIAL/GRAPHICS SECTION

Mark A. Lowery, Geographer-11
Violet W. Fetner, Writer/Editor-11
James R. Douglas, Sci Illust-09
Vacant, Illustrator-07
Patricia A. Deeds, Edit Asst-06
Cindy R. Myer, Edit Asst-06

SPECIALIST SECTION

C. Lamar Sanders, Hydrologist (SW)-13
Bruce G. Campbell, Hydrologist (GW)-13
Woodrow Wang, Hydrologist (QW)-13

HYDROLOGIC SYSTEM ANALYSIS SECTION

Noel M. Hurley, Jr., Supv. Hydrologist-13
Stephen T. Benedict, Hydrologist-12
David E. Bower, Hydrologist-12
Timothy H. Lanier, Hydrologist-11
Michael G. Zalants, Hydrologist-11
Andral W. Caldwell, Hydraulic Engineer-09
Toby D. Feaster, Hydrologist-11
Troy J. Dover, Hydrologic Technician-06

HYDROLOGIC INVESTIGATIONS SECTION

Marjorie S. Davenport, Asst District Chief-13
Ted R. Campbell, Hydrologist-12
W. Fred Falls, Hydrologist-11
Wladmir B. Guimaraes, Hydrologist-11
Larry G. Harrelson, Hydrogist-11
J. Fred Robertson, Hydrologist-11
Doug D. Nagle, Hydrologist-09
Matthew D. Petkewich, Hydrologist-09
John M. Barton, Hydrologic Technician-09

MICROBIAL STUDIES UNIT

Francis H. Chapelle, RGE-Hydrologist-15 RSO
Don A. Vroblesky, RGE-Hydrologist-14
Paul M. Bradley, RGE-Hydrologist-13
James E. Landmeyer, Hydrologist-12

FIELD HEADQUARTERS - MT. PLEASANT, SC

Bruce G. Campbell, Hydrologist-13
June E. Mirecki, Hydrologist-11 (I)
Kevin J. Conlon, Hydrologist-09

HYDROLOGIC SURVEILLANCE AND ANALYSIS SECTION

Theodore W. Cooney, Asst District Chief-13
Paul A. Conrads, Hydrologist-12
Kathy H. Jones, Hydrologist-11
Vacant, Hydrologist-9/11
Henry E. Herlong, Hydrologic Technician-11
Bill W. Church, Hydrologic Technician-10
Gregory L. Murray, Hydrologic Technician-10
T. Keith Durham, Materials Handler-04

FIELD HEADQUARTERS - COLUMBIA, SC

John W. Gissendanner, Supv Hydrologic Technician-11
James M. Hall, Hydrologic Technician-09
Sarah W. Logan, Hydrologic Technician-09
Brian F. Wahl, Hydrologic Technician-09
Frank H. Dew, Hydrologic Technician-08
Jan M. Bullock, Hydrologic Technician-07
Albert A. Jackson, Hydrologic Technician-07
Brian L. Daniels, Hydrologic Technician-06
Dale F. Skipper, Hydrologic Technician-06

FIELD HEADQUARTERS - NEW ELLENTON, SC

Vacant, Supv Hydrologic Technician-11
Frank Melendez, Hydrologic Technician-10
Thomas E. Moad, Hydrologic Technician-06
Vacant, Hydrologic Technician-04

FIELD HEADQUARTERS - MYRTLE BEACH, SC

Paul A. Drewes, Supv Hydrologist-12
Ivan S. Roberts, Hydrologic Technician-10
John W. Erbland, Hydrologic Technician-09

FIELD HEADQUARTERS - MT. PLEASANT, SC

Brady K. Long, Hydrologic Technician-08

District Chief	Regional Hydrologist	Personnel
Date	Date	Date