

ENVIRONMENTAL SCIENCES DIVISION
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PERSONAL INFORMATION:

Home Address: 2209 Misty Trace
Knoxville, TN 37919

Born: November 13, 1959
Happily Married (Sharon, 15 years), 2 wild/wonderful children
(Meg 10, Philip "Tony" 13)

PROFESSIONAL OBJECTIVE:

Continue to develop advanced research and teaching programs that enhance knowledge and prediction of geosphere dynamics as they are altered by natural and anthropogenic perturbations. These efforts focus on the integration of hydrological, geochemical, and microbiological processes that influence subsurface and surface nutrient and contaminant fate and transport in the Earth ecosystem. My current professional interests focus on the experimental and theoretical aspects of subsurface solute, colloidal, and contaminant transport at multiple scales ranging from molecular to the landscape levels for problems of global significance.

EDUCATION:

Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Ph.D. Soil Chemistry/Physics GPA 3.76, March 1983 - December 1985.

University of Delaware, Newark, Delaware. M.S. Soil Chemistry GPA 3.80, June 1981 - February 1983.

University of Delaware, Newark, Delaware. B.S. Soil Chemistry and minor in Chemistry. GPA 3.50. Degree with Distinction and Cum Laude. September 1977 - June 1981.

EXPERIENCE:

Subsurface Hydrogeochemist; Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, Tennessee (10/86 to present) Hired by Robert J. Luxmoore. Present title: Distinguished Research Staff Scientist

Research topics:

Influence of coupled physical, chemical, and microbial processes on the fate and transport of contaminants in soil and rock systems at multiple scales.

Quantifying time-dependent (non-equilibrium) transport mechanisms that control contaminant migration in humid regime fractured subsurface systems and semi-arid porous subsurface systems at both the laboratory and field scales.

Subsurface transport model development, validation, and uncertainty analysis in heterogeneous field soils.

Experimental and theoretical aspects of dissolved organic carbon, contaminant, and co-contaminant transport in undisturbed, variably unsaturated soils at multiple scales.

Influence of soil physical and geochemical properties on toxic metal bioaccessibility.

Novel soil amendment strategies to decrease toxic soil metal bioavailability.

Significance of contaminant co-transport in soils via inorganic and organic colloids.

Hydrogeochemical factors controlling the transport and sequestration of dissolved organic carbon and solutes in soil.

Teaching Experience: Frequent guest lecturer for the University of Tennessee in the classes "Advanced Soil Physics" and "Field and Laboratory Methods in Hydrogeology".

Adjunct Professor, Department of Geological Sciences, University of Tennessee.

Post Doctoral Research Associate; Department of Agronomy, Virginia Polytechnic Institute and State University, Blacksburg, Virginia (12/85 to 10/86) (employer: Lucian W. Zelazny).

Research topics:

Speciation of complex inorganic and organic aluminum solutions through differential kinetic reactions with ferron.

Teaching experience: Instructor of selected topics in the graduate classes entitled "Advanced Soil Chemistry" and "Soil Physical and Colloidal Chemistry".

Graduate Research Assistant (Ph.D.); Department of Agronomy, Virginia Polytechnic Institute and State University, Blacksburg, Virginia (3/83 to 12/85) (Major Professors. Drs. Lucian Zelazny and John C. (Jack) Parker)

Research topics:

Speciation of inorganic aluminum solutions and modeling their kinetics and mechanisms of adsorption on selected solids.

Effects of multisite ion selectivity and adsorption kinetics on heterovalent cation transport in soil.

Teaching experience: Instructed undergraduate soils laboratory for two quarters during Ph.D. studies.

Graduate Research Assistant (M.S.); Department of Plant and Soil Science, University of Delaware, Newark, Delaware (6/81 to 2/83) (Major Professor Dr. Donald L. Sparks).

Research topics:

Kinetics and thermodynamics of K-Ca exchange on clays and soils.

Independent Undergraduate Research, Department of Plant and Soil Science, University of Delaware, Newark, Delaware (9/80 to 6/81) (Major Professor Dr. Donald L. Sparks).

Research topic:

Kinetic and thermodynamic analysis of K reactions in soils as affected by Al, Ca, and Mg.

Independent Undergraduate Research, Department of Chemistry, University of Delaware, Newark, Delaware (11/79 to 6/80).

Research topic:

Mechanisms of inactivation of the enzyme Acyl-CoA dehydrogenase using active-site specific reagents.

HONORS:

Distinguished Alumni Award, University of Delaware, College of Agriculture and Natural Resources, 2008.

Significant Event Award, for successfully obtaining a competitive, \$15 M, 5y DOE project entitled “Multi-scale Investigations on the Rates and Mechanisms of Targeted Immobilization and Natural Attenuation of Metal, Radionuclide, and Co-Contaminants in the Subsurface” involving five Universities and three National Laboratories. Oak Ridge National Laboratory, 2007.

Highly Cited Researchers in Environmental Studies, The Institute for Scientific Information, (ISI), 2003.

Soil Science **Research Award,** Soil Science Society of America, 1998.

One of three finalists in the category of Scientific and/or Technological Development for The **Outstanding Young Persons in the World** Program (TOYP), International Junior Chamber of Commerce, 1998.

Ten Outstanding Young Americans, United States Junior Chamber of Commerce, 1998.

Presidential Citation for **Outstanding Achievement**, University of Delaware, 1997.

Presidential Early Career Award for Scientist and Engineers, The President of the United States of America (William Clinton), Washington, D.C., 1996.

Young Independent Scientist Award, Department of Energy, Office of Energy Research, 1996

Oak Ridge National Laboratory **Research and Development Accomplishment Award**, ORNL, 1995

Scientific Achievement Award, Environmental Sciences Division, ORNL, 1993

Sigma Xi **Research award**, Virginia Tech, 1987.

Potash and Phosphate Institute **fellowship award**. University of Delaware, 1982.

Undergraduate **degree with distinction and cum laude**. University of Delaware, 1981.

Sigma Xi **outstanding undergraduate research award**. University of Delaware, 1981.

American Society of Agronomy **outstanding undergraduate award**. University of Delaware, 1981.

PUBLICATION AWARDS

“Hot Paper” Achievement 2008, Thomson Scientific (ISI) Essential Science Indicators, most citations in a two-month period for a paper published within the past two years. Article: Wu., W.M., J. Carley, S. Carroll, O. Cirpka, M.W. Fields, M. Fienen, M.E. Gentile, T. Gentry, M.A. Ginder-Vogel, R.F. Hickey, J. Luo, T.L. Mehlhorn, J. Nyman, H. Yan, D.B. Watson, J. Zhou, S.E. Fendorf, P. Kitanidis, P.M. Jardine, and C.S. Criddle. 2006. Pilot-scale in situ bioremediation of uranium in a highly contaminated aquifer II: Reduction of U(VI) and geochemical control of U(VI) bioavailability. Environ. Sci. Technol. 40 (12): 3986-3995.

Most-Cited Article Published in 2006, Thomson Scientific (ISI) Essential Science Indicators, most citations through the period ending December 31, 2007. Article: Wu., W.M., J. Carley, S. Carroll, O. Cirpka, M.W. Fields, M. Fienen, M.E. Gentile, T. Gentry, M.A. Ginder-Vogel, R.F. Hickey, J. Luo, T.L. Mehlhorn, J. Nyman, H. Yan, D.B. Watson, J. Zhou, S.E. Fendorf, P. Kitanidis, P.M. Jardine, and C.S. Criddle. 2006. Pilot-scale in situ bioremediation of uranium in a highly contaminated aquifer II: Reduction of U(VI) and geochemical control of U(VI) bioavailability. Environ. Sci. Technol. 40 (12): 3986-3995.

Award of Excellence, Society for Technical Communication / East Tennessee Chapter 2000. Publication: Jardine, P.M., S.E. Fendorf, M.A. Mayes, I.L. Larsen, S.C. Brooks, and W.B. Bailey. 1999. Fate and transport of hexavalent chromium in undisturbed heterogeneous soil. Environ. Sci. Technol. 33:2939-2944.

Award of Excellence, Society for Technical Communication / East Tennessee Chapter 2000. Publication: Brooks, S.C., S.L. Carroll, and P.M. Jardine. 1999. Sustained bacterial reduction of

Co(III)EDTA⁻ in the presence of competing geochemical oxidation during dynamic flow. Environ. Sci. Technol. 33:3002-3011.

Award of Achievement, Society for Technical Communication / East Tennessee Chapter 1997. Publication: Brooks, S.C., D.L. Taylor, and P.M. Jardine. 1996. Reactive transport of EDTA-complexed cobalt in the presence of ferrihydrite. *Geochimica et Cosmochimica Acta*. 60:1899-1908.

Best Presentation, Division S-7 of the Soil Sci. Soc. Am. 2003. "J. R. Tarver, J. A. Palmer, D. E. Todd, and P. M. Jardine. 2003. Fate and Transport of Dissolved Organic Carbon in Soils from two Contrasting Watersheds. Soil Science Society of America, Nov. 2-6, 2003. Denver, CO".

GENERAL REVIEW ACTIVITIES:

Review ~ 5 papers per year for Soil Science Society of America, Water Resources Research, Journal of Environmental Quality, Geoderma, J. Hydrologic Processes, *Geochimica et Cosmochimica Acta*, Environmental Science and Technology, Nature and other publications.

Review several research proposals and reports each year for U.S. Environmental Protection Agency, U.S. Department of Agriculture, National Science Foundation, and U.S. Department of Energy.

PROFESSIONAL ACTIVITIES:

Advisory Committee Member, International Conference on Hydropedology, USDA-National Research Initiative and Penn State Univ., the International Union of Soil Sciences' Working Group on Hydropedology. Penn State in July 28-31, 2008.

Advisory Board Member, Center for Environmental Kinetics Analysis (CEKA) which is a collaboration of the NSF Environmental Molecular Science Institute program, U.S. Department of Energy, and Penn State, 2005-present.

Associate Editor *Vadose Zone Journal* 2001-2003.

Chairman, division S-11 of the Soil Science Society of America 1996-1997.

Chair-Elect, division S-11 of the Soil Science Society of America 1995-1996.

Adjunct Professor, Department of Geological Sciences, University of Tennessee, 1996-present.

Associate Editor *Soil Science Society America Journal* 1991-1995.

Paper Recycling Coordinator for Oak Ridge National Laboratory 1990-1993. This program was voluntarily developed and initiated by myself and two other staff members and serves over 4000 employees. Responsibilities turned over to the Division of Waste Management, ORNL in 1993.

Toner Cartridge and paper recycling representative for the Environmental Sciences Division, ORNL 1994-present.

PREVIOUS RESEARCH GRANTS AND CONTRACTS:

"Subsurface transport model validation and minimum parameter requirements in heterogeneous field soils" (principal investigator with G.V. Wilson), DOE Subsurface Science Program, 5/89 - 9/92, \$425,000.

"Soil-water-waste interactions: controls on contaminant release and transport" (principal investigator with G.K. Jacobs) DOE Subsurface Science Program, 5/89 - 9/92, \$395,000.

"Experiments with natural organics" (co-principal investigator with J.F. McCarthy) DOE Subsurface Science Program, 6/87 - 5/94, \$400,000/y.

"Spatial Heterogeneity of Subsurface Microbial, Chemical, and Physical Processes" (co- investigator with A.V. Palumbo) DOE Subsurface Science Program, 1994, \$300,000.

"Characterization and microbial utilization of organic carbon" (co- principal investigator with J.F. McCarthy) DOE Deep Subsurface Subprogram, 10/90 - 5/94, \$150,000/y.

"Field-scale validation of a three-dimensional multispecies hydrogeochemical transport model" (principal investigator) DOE Subsurface Science Program, 10/91 - 10/94, \$450,000.

"Co-Contaminant transport in subsurface media" (principal investigator) DOE Subsurface Science Program, 10/92-10/94, \$320,000.

"Quantifying the diffusive mass transfer of tritium within secondary source regimes at WAG 5" (principal investigator) Energy Systems Environmental Restoration Program, 10/92-10/94, \$380,000/y.

"Quantifying mass transfer kinetics within secondary source regimes using undisturbed subsurface columns" (principal investigator) Energy Systems Environmental Restoration Program, 10/92-10/94, \$180,000/y.

"Chemical and microbial controls on co-contaminant fate and transport" (principal investigator) DOE Subsurface Science Program, 10/94 \$300,000/y, 10/95-present \$350,000/y.

"Fracture Flow and Matrix Diffusion at Laboratory and Field Scales" (principal investigator) Groundwater Operable Units, Energy Systems Environmental Restoration Program, 10/94-10/95, \$293,000.

"Measurement of Oxide-Mineral Reduction Using X-ray Absorption Spectroscopy" (principal investigator with S.C. Brooks) Seed Money Fund, Laboratory Directed Research and Development Program, 1996, \$103,000.

"A Parallel Computer Model and Integrated Visualization System for Assessing the Migration of Industrial Mixed Waste Plumes: Development and Field-Scale Applications" (principal investigator with J.P. Gwo) Environmental Technology Partnership Initiative, 1996, \$386,000.

"Containment of toxic metals and radionuclides in porous and fractured media: Optimizing biogeochemical reduction versus geochemical oxidation". (principal investigator with S.C. Brooks) Environmental Management Science Program, 1996-1999, \$450,000/y for 3 y.

"Influence of Coupled Processes on the Fate and Transport of Industrial Mixed Waste Plumes in Structured Media". (principal investigator with J.P. Gwo) Environmental Technology Partnership Initiative, 1997-2000, \$500,000/y for 3y.

"Behavior of Dense, Immiscible Solvents in Fractured Clay-rich Soils". (principal investigator with L.D. McKay) Environmental Management Science Program, 1996-1999, \$200,000/y for 3 y.

"Microbiological Controls on the Fate and Transport of Chelated Radionuclides: Multiscale Investigations in Unsaturated Structured Media" (principal investigator with S.C. Brooks) DOE Natural and Accelerated Bioremediation Program, 1997-2000, \$450,000/y for 3 y.

"Fate and Transport of Radionuclides Beneath the Hanford Tank Farms: Unraveling Coupled Geochemical and Hydrological Processes in the Vadose Zone" (principal investigator) U.S. Dept. of Energy, Environmental Management Science Program, FY00-FY02, \$425,000/y for 3y.

"Fate and Transport of ⁹⁰Sr Beneath the Hanford Tank Farms" (principal investigator) U.S. Department of Energy, Hanford Environmental Management program, FY00-FY02. 150,000/y.

"Quantifying the Bioavailability of Toxic Metals in Soils" (principal investigator with M.O. Barnett and S.E. Fendorf) U.S. Dept. of Defense SERDP program, FY00 - FY04, \$1,350,000.

"Field-scale evaluation of biostimulation for remediation of uranium-contaminated groundwater at a proposed NABIR Field Research Center in Oak Ridge, Tennessee" (principal investigator with C.S. Criddle) DOE Natural and Accelerated Bioremediation Program, 2001-2004. \$5,000,000.

"Microbially mediated immobilization of contaminants through in situ biostimulation" (principal investigator with S.C. Brooks and S.E. Fendorf) U.S. Dept. of Energy, Environmental Management Science Program, 2001-2003. \$1,200,000.

"Coupled Hydrological and Geochemical Processes Governing the Fate and Transport of Radionuclides and Toxic Metals in the Hanford Vadose Zone" (principal investigator with M.A. Mayes and S.E. Fendorf) U.S. Dept. of Energy, Environmental Management Science Program, FY03-FY05, \$325,000/y for 3y.

"Microbially Mediated Immobilization of Contaminants Through In Situ Biostimulation: Re compete of EMSP ERKP602" (principal investigator). U.S. Dept. of Energy, Environmental Management Science Program, FY04-FY06, \$484,000.

"Proposal for a NABIR Field Research Center on the Oak Ridge Reservation, Tennessee" DOE Natural and Accelerated Bioremediation Program, FY00-06, \$2,100,000/y (contributing investigator).

"Science Advisor for the NABIR Field Research Center on the Oak Ridge Reservation, Tennessee" DOE Natural and Accelerated Bioremediation Program, FY02 - open, \$70,000/y (principal investigator).

"Enriched Background Isotope Study (EBIS): Litter reciprocal transplant studies to understand sources, transport and fate of carbon in soils and watersheds" (principal investigator with many others) DOE Carbon Sequestration Research Program, 2001-2006. \$3,500,000.

“Decreasing Toxic Metal Bioavailability with Novel Soil Amendment Strategies” (principal investigator with M.O. Barnett and S.E. Fendorf). U.S. Dept. of Defense SERDP program, FY03 - FY06, \$1,500,000.

“Elucidating Bioreductive Transformations within Physically Complex Media: Impact on the Fate and Transport of Uranium and Chromium” (co-principal investigator with S.E. Fendorf). DOE Natural and Accelerated Bioremediation Program, FY04 - FY06, ORNL portion \$130,000/y for 3 y.

"Field-scale evaluation of strategies to prevent remobilization of biologically reduced uranium deposits" (principal investigator with C.S. Criddle) DOE Natural and Accelerated Bioremediation Program, 2004-2007. \$1,000,000/y.

“Monitoring the Influence of Remedial Capping on the Hydrological, Geochemical, and Microbial Processes that Control Subsurface Contaminant Migration at WAG 5 on the Oak Ridge Reservation: Implications Toward Long-Term Stewardship” U.S. Dept. of Energy, Environmental Management Science Program. FY05-06, \$330,000

“Effects of Groundwater Chemistry on the Distribution of Soil Microorganisms in Natural Media”. (principal investigator with T.L. Bank, Univ. Buffalo). Laboratory Directed Research and Development Seed Money Program, ORNL FY06-FY07. \$135,000.

“Hydrological and Geochemical Controls on the Fate and Transport of Cr(VI), U, and CoEDTA in Undisturbed Sediments from the Hanford 200E Area” (co-investigator with Mayes as PI). Ch2m HILL Hanford Group, Inc. \$150K FY05; \$150K FY06; \$150K FY07, \$150K FY08.

“Quantifying Scale-dependent Hydrological and Geochemical Processes Governing the Fate and Transport of Radionuclides and Toxic Metals in the Hanford Vadose Zone” (co-investigator with Mayes (PI), Perfect, Gwo, and Fendorf). U.S. Dept. of Energy, Environmental Management Science Program. FY 06-08, \$1,500,000.

CURRENT RESEARCH GRANTS AND CONTRACTS:

“Multi-scale Investigations on the Rates and Mechanisms of Targeted Immobilization and Natural Attenuation of Metal, Radionuclide, and Co-Contaminants in the Subsurface” (principal investigator in collaboration with ANL, LBNL, FSU, OU, Stanford Univ., Georgia Tech, Univ. Tennessee). U.S. Dept. of Energy, Environmental Remediation Sciences Program. (FY07 – FY11 funding), \$15,000,000 over 5 years.

“Center for Research on Enhancing Carbon Sequestration in Terrestrial Ecosystems. A joint effort among ORNL, PNNL, and ANL. DOE Climate Change Technology Initiative: Establishment of Centers for Research on Carbon Sequestration in Terrestrial Biosphere and the Ocean.” FY00-open, \$2,500,000/y (principal investigator with many others).

“The Effect of Soil Properties on Decreasing Toxic metal Bioavailability: Field Scale Validation to Support Regulatory Acceptance” (principal investigator). Department of Defense, Environmental Security Technology Certification Program (ESTCP). 2005-2008, \$1,300,000.

“Colloid-Facilitated Transport of Radioactive Cations in the Vadose Zone: Field Experiments at Oak Ridge National Laboratory” U.S. Dept. of Energy, Environmental Remediation Science Program (FY08 – FY10 funding). co-PI with PI-Ryan (University of Colorado). ORNL portion \$250,000.

“Remediation Initiative Implementation Plan: Mercury Stabilization” U.S. Department of Energy, Environmental Management–22 program. 2008-2011, \$300–\$600 K per year, (contributing investigator).

PENDING:

“Biogeochemical and Transport Process Model Upscaling, Identification, Calibration and Uncertainty Analysis for Subsurface Uranium Remediation”. U.S. Dept. of Energy, Environmental Remediation Sciences Program. (FY09 – FY12 funding), co-PI with PI-Parker (University of Tennessee).

“Sequestration of Uranium within the Subsurface: Redox Stable Phases Resulting from Incorporation in Iron Oxides”. U.S. Dept. of Energy, Environmental Remediation Sciences Program. (FY09 – FY12 funding), co-PI with PI-Fendorf (Stanford University).

“Geochemical Factors Controlling Uranium Dissolution and Transport from Oak Ridge Reservation Sediments”. U.S. Dept. of Energy, Environmental Remediation Sciences Program. (FY09 – FY12 funding), co-PI with PI-Sparks (University of Delaware).

"Identifying and Quantifying Conditions Responsible for the Enhanced Subsurface Transport of Transuranic Contaminants: Impacts of Coupled, Multiphase Processes in Heterogeneous Media". U.S. Dept. of Energy, Environmental Remediation Sciences Program. (FY10 – FY15 funding), co-PI with PI-Brooks (ORNL) and collaborations with SRNL and Clemson. \$1,200,000 per year for 5 y.

PUBLISHED MANUSCRIPTS (peer-reviewed = 135):

Sparks, D.L., and P.M. Jardine. 1981. Thermodynamics of potassium exchange in soil using a kinetic approach. *Soil Sci. Soc. Am. J.* 45:1094-1099.

Jardine, P.M., and D.L. Sparks. 1984. Potassium-calcium exchange in a multireactive soil system: I. Kinetics. *Soil Sci. Soc. Am. J.* 48:39-45.

Jardine, P.M., and D.L. Sparks. 1984. Potassium-calcium exchange in a multireactive soil system: Thermodynamics. *Soil Sci. Soc. Am. J.* 48:45-50.

Sparks, D.L., and P.M. Jardine. 1984. Comparison of kinetic equations to describe potassium-calcium exchange in pure and in mixed systems. *Soil Sci.* 138:115-122.

Jardine, P.M., L.W. Zelazny, and J.C. Parker. 1985. Mechanisms of Al adsorption on clay minerals and peat. *Soil Sci. Soc. Am. J.* 49:862-867.

Jardine, P.M., J.C. Parker, and L.W. Zelazny. 1985. Kinetics and mechanisms of Al adsorption on kaolinite using a two site nonequilibrium transport model. *Soil Sci. Soc. Am. J.* 49:876-873.

Parker, J.C., and P.M. Jardine. 1986. Effects of heterogeneous adsorption behavior on ion transport. *Water Resour. Res.* 22:1334-1340.

- Jardine, P.M., L.W. Zelazny, and A. Evans Jr. 1986. Solution aluminum anomalies resulting from various filtering materials. *Soil Sci. Am. J.* 50:891-894.
- Jardine, P.M., and L.W. Zelazny. 1986. Mononuclear and polynuclear aluminum speciation through differential kinetic reactions with ferron. *Soil Sci. Soc. Am. J.* 50:895-900.
- Jardine, P.M. and L.W. Zelazny. 1987. Influence of organic anions on the speciation of mononuclear and polynuclear aluminum by ferron. *Soil Sci. Soc. Am. J.* 51:885-889.
- Jardine, P.M., and L.W. Zelazny. 1987. Influence of inorganic anions on the speciation of mononuclear and polynuclear aluminum by ferron. *Soil Sci. Soc. Am. J.* 51:889-892.
- Jardine, P.M., G.V. Wilson, and R.J. Luxmoore. 1988. Modeling the transport of inorganic ions through undisturbed soil columns from two contrasting watersheds. *Soil Sci. Soc. Am. J.* 52:1252-1259.
- Jardine, P.M., G.V. Wilson, R.J. Luxmoore, and J.F. McCarthy. 1989. Transport of inorganic and natural organic tracers through an isolated pedon in the field. *Soil Sci. Soc. Am. J.* 53:317-323.
- Wilson, G.V., J.M. Alfonsi, and P.M. Jardine. 1989. Spatial variability of subsoil hydraulic properties of two forested watersheds. *Soil Sci. Soc. Am. J.* 53:679-685.
- Jardine, P.M. N.L. Weber, J.F. McCarthy. 1989. Mechanisms of dissolved organic carbon adsorption by soil. *Soil Sci. Soc. Am. J.* 53:1378-1385.
- Jardine, P.M., G.V. Wilson, and R.J. Luxmoore. 1990. Unsaturated solute transport through a forest soil during rain events. *Geoderma.* 46:103-118.
- Luxmoore, R.J., P.M. Jardine, G.V. Wilson, J.R. Jones, and L.W. Zelazny. 1990. Physical and chemical controls of preferred path flow through a forested hillslope. *Geoderma.* 46:139-154.
- Wilson, G.V., P.M. Jardine, R.J. Luxmoore, and J.R. Jones. 1990. Hydrology of a forested watershed during storm events. *Geoderma.* 46:119-138.
- Jardine, P.M., G.V. Wilson, J.F. McCarthy, R.J. Luxmoore, and D.L. Taylor. 1990. Hydrogeochemical processes controlling the transport of dissolved organic carbon through a forested hillslope. *J. Contaminant Hydrology.* 6:3-19.
- Wilson, G.V., P.M. Jardine, R.J. Luxmoore, L.W. Zelazny, D.A. Lietzke, and D.E. Todd. 1991. Hydrogeochemical processes controlling subsurface transport from an upper subcatchment of Walker Branch watershed during storm events: 1. Hydrologic transport processes. *J. Hydrology.* 123:297-316.
- Wilson, G.V., P.M. Jardine, R.J. Luxmoore, L.W. Zelazny, D.E. Todd, and D.A. Lietzke. 1991. Hydrogeochemical processes controlling subsurface transport from an upper subcatchment of Walker Branch watershed during storm events: 2. Solute transport processes. *J. Hydrology.* 123:317-336.

- Mulholland, P.J., G.V. Wilson, and P.M. Jardine. 1990. Hydrogeochemical response of a forested watershed: Effects of preferential flow along shallow and deep pathways. *Water Resour. Res.* 26:3021-3036.
- Dunnivant, F.M., P.M. Jardine, D.L. Taylor, and J.F. McCarthy. 1992. Co-transport of cadmium and hexachlorobiphenyl by dissolved organic carbon through columns containing aquifer material. *Environ. Sci. Technol.* 26:360-368.
- Dunnivant, F.M., P.M. Jardine, D.L. Taylor, and J.F. McCarthy. 1992. Transport of naturally occurring dissolved organic carbon in laboratory columns containing aquifer material. *Soil Sci. Soc. Am. J.* 56:437-444.
- Jardine, P.M., F.M. Dunnivant, H.M. Selim, and J.F. McCarthy. 1992. Comparison of models for describing the transport of dissolved organic carbon in aquifer columns. *Soil Sci. Soc. Am. J.* 56:393-401.
- O'Dell, J.D., J.D. Wolt, and P.M. Jardine. 1992. Transport of Imazethapyr in undisturbed soil columns as related to persistence in soil solution. *Soil Sci. Soc. Am. J.* 56:1711-1715.
- Wilson, G.V., P.M. Jardine, J.D. O'Dell, and M. Collineau. 1993. Field-scale transport from a buried line source in unsaturated soil. *J. Hydrology* 145:83-109.
- Wilson, G.V., P.M. Jardine, J.P. Gwo. 1992. Modeling the hydraulic properties of a multi-region soil. *Soil Sci. Soc. Am. J.* 56:1731-1737.
- Jardine, P.M., G.K. Jacobs, and G.V. Wilson. 1993. Unsaturated transport processes in undisturbed heterogeneous porous media. I. Inorganic Contaminants. *Soil Sci. Soc. Am. J.* 57:945-953.
- Jardine, P.M., G.K. Jacobs, and J.D. O'Dell. 1993. Unsaturated transport processes in undisturbed heterogeneous porous media II. Co-Contaminants. *Soil Sci. Soc. Am. J.* 57:954-962.
- McCarthy, J.F., T.M. Williams, L. Liang, P.M. Jardine, A.V. Palumbo, L.W. Cooper, L.W. Jolley, and D.L. Taylor. 1993. Mobility of natural organic matter in a sandy aquifer. *Environ. Sci. Technol.* 27:667-676.
- Jardine, P.M. and D.L. Taylor. 1995. Fate and Transport of Ethylenediaminetetraacetate Chelated Contaminants in Subsurface Environments. In D.L. Sparks (ed.) *Soil Environmental Chemistry*. Elsevier Science Publishers, The Netherlands (Geoderma 67:125-140).
- Gwo, J.P., P.M. Jardine, G.V. Wilson, and G.T. Yeh. 1995. A multiple-pore-region concept to modeling mass transfer in subsurface media. *J Hydrol.* 164:217-237.
- Kooner, Z.S., P.M. Jardine, S. Feldman. 1995. Competitive surface complexation reactions of SO_4^{2-} and natural organic carbon on soil. *J. Environ. Qual.* 24:656-662.
- Taylor, D.L. and P.M. Jardine. 1995. Analysis of Co(II)EDTA and Co(III)EDTA in pore water by ion chromatography. *J. Environ. Qual.* 24:789-792.

- Jardine, P.M. and D.L. Taylor. 1995. Kinetics and mechanisms of Co(II)EDTA oxidation by pyrolusite. *Geochimica et Cosmochimica Acta*. 59:4193-4203.
- Gwo, J.P., P.M. Jardine, G.V. Wilson, and G.T. Yeh. 1996. Using a multiregion model to study the effects of advective and diffusive mass transfer on local physical nonequilibrium and solute mobility in a structured soil. *Water Resour. Res.* 32:561-570.
- Brooks, S.C., D.L. Taylor, and P.M. Jardine. 1996. Reactive transport of EDTA-complexed cobalt in the presence of ferrihydrite. *Geochimica et Cosmochimica Acta*. 60:1899-1908.
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**BOOK CHAPTERS, PROCEEDINGS, TECHNICAL MANUSCRIPTS, SPECIAL PUBLICATIONS
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