Daniel J. Goode, Ph.D., USGS

RESEARCH SCIENTIST RECORD (partial)

(1) EDUCATION

Princeton	Civil Engineering and Operations Research	Ph.D., 1998
Princeton	Civil Engineering and Operations Research	M.A., 1995
M.I.T.	Civil Engineering	M.S., 1982
M.I.T.	Civil Engineering	B.S., 1980

(2) TECHNICAL TRAINING RECEIVED

Course	**Institution**	**Duration**	**Year**
Stochastic & Geostatistical Analysis for Groundwater Modeling	International Ground-Water Modeling Center	1 week	1987
Chemistry for Ground-Water Solute Transport Models	USGS	2 weeks	1987
Parameter Estimation Techniques for Ground-Water Models	USGS	2 weeks	1988
Role of Fluids in Geologic Processes	Stanford University	1 quarter	1991
Hydraulic & Tracer Tests	Stanford University	1 quarter	1992
HEC-ResSim Workshop	USACE Hydrologic Engineering Center	1 week	2008
ModelMuse G.W. Model Preprocessor	USGS	2 days	2010
Groundwater Model Calibration	USGS	5 days	2012

(3) PROFESSIONAL EXPERIENCE

a. PRESENT ASSIGNMENTS

My research centers on improving field techniques and synthesis methods for flow and reactive transport processes in fractured-rock aquifers. Fractured-rock aquifers are an important resource for the nation and innovative solutions are required to help protect, manage, and remediate this resource. My research improves understanding of complex biologic, geochemical, and hydrologic systems in highly heterogeneous formations. The extreme heterogeneity associated with fractured rock has limited the development of adequate field and modeling methods. Research applications include characterization and bioremediation of sedimentary rock aquifers contaminated with chlorinated solvents, quantitative method development for groundwater flow and geochemical processes in flooded coal mines, and water resources evaluation in fractured-rock terranes.

DATES From: 2004 To: Present
Chlorinated solvents in fractured sedimentary rock

Project Co-coordinators: Claire Tiedeman and Dan Goode
Funding: USGS Toxic Substances Hydrology Program

Multi-disciplinary research on fate and transport of chlorinated solvent contaminants in fractured-rock aquifers, especially related to NAPLs and matrix diffusion. As co-coordinator with Claire Tiedeman, provide project technical leadership and coordinate research, especially field activities, for diverse efforts by USGS and other researchers. Formulate long-term plans and goals for the project, in consultation with other team members, and compile and prepare programmatic reports. Work with NRP researchers, especially Claire Tiedeman and Allen Shapiro, in identifying overall scientific goals for the project. Conduct research on matrix diffusion and delineation of VOC distribution by direct sampling of rock core and VOC analysis. (30% of my time)

DATES From: 2007 To: Present
Comparison of Pump-and-Treat, Natural Attenuation, and Enhanced Biodegradation to Remediate Chlorinated Ethene-Contaminated Fractured Rock Aquifers
Principal Investigator: Allen Shapiro
Funding: Strategic Environmental Research and Development Program (DOD/EPA/DOE)
Conduct research on delineation of VOC contamination in fractured-rock aquifers. Develop field and analysis methods for characterizing the mass of DNAPL and dissolved contaminants, and for estimating diffusion properties for assessment of remediation and monitoring. (10%)

DATES From: 2007 To: Present
Characterization and remediation of contaminated fractured-rock sites
Project Chief: Claire Tiedeman
Funding: EPA Ofc. of Superfund Remediation and Technology Innovation
Provide guidance to EPA and state regulatory community on evaluation of capture zones for pump and treat systems in fractured rock. (5%)

DATES From: 2011 To: Present
Water Science Support for USAID / Jordan
Project Chief: Dan Goode
Funding: U.S. Agency for International Development

Technical assistance in fractured-rock hydrology and water quality. Provide guidance for USAID development assistance to help Jordan improve water-resources science and management. Forecast groundwater resource quantity and quality. Build capacity of government of Jordan to monitor, protect, and manage water resources. (20%)

DATES From: 2008 To: Present
Flooded Coal Mines: Water Resources Development and Groundwater/Surface-Water Interactions
Project Chief: Chuck Cravotta

Funding: Pennsylvania Dept. of Environmental Protection / USGS Water Co-op

Develop numerical models of flow in complex of flooded underground coal mines to evaluate use of mines as water resource, and effects of streamflow restoration in mined areas. (10%)

DATES From: 1994 To: Present

Characterization and Remediation of Fractured-Rock Superfund Sites in SE Pennsylvania

Project Chief: Lisa Senior

Funding: EPA Superfund Region 3

Evaluate the effects of pumping on flow directions and contaminant migration in highly heterogeneous, sedimentary-rock aquifers using models. Research on simulation methods, parameter estimation and uncertainty analysis. (5%)

b. PREVIOUS PROFESSIONAL POSITIONS

DATES From: 2007 To: 2009

Delaware River Basin Flood-Analysis Model: Project Chief. Coordinator and technical team leader for multi-agency project with Delaware River Basin Commission, USGS (PaWSC, NJ WSC, & NRP), NOAA's National Weather Service, and U.S. Army Corps of Engineers Hydrologic Engineering Center.

DATES From: 2000 To: 2005

U.S. Regional Coordinator – Water Data Banks: Diplomat for State Dept. at U.S. Embassy Tel Aviv facilitating Israeli, Palestinian, and Jordanian collaborations for Multilateral Working Group on Water Resources, Middle East Peace Process. (exact-me.org)

DATES From: 1994 To: 2000

Research Hydrologist, USGS Pennsylvania Water Science Center: Research, technical assistance, training and technical leadership in fractured-rock hydrology and groundwater modeling.

DATES From: 1993 To: 1994

USGS Water Resources Division Graduate School Training Program: Princeton University (Ph.D. 1998).

DATES From: 1991 To: 1993

Research Hydrologist, USGS (Water) National Research Program, Hydrology of Fractured Rocks (Hsieh). I conducted research for the USGS Toxic Substances Hydrology Program fractured-rock research site at Mirror Lake, N.H.

DATES From: 1987 To: 1990

Research Hydrologist, USGS (Water) National Research Program, Digital

Modeling of Transport in Saturated Zone (Konikow). I conducted research on flow and transport modeling, and developed the initial code for MOC3D.

DATES From: 1983 To: 1986

Hydrogeologist, U.S. Nuclear Regulatory Commission, Waste Disposal Div. I was the lead hydrogeologist for low-level radioactive waste disposal sites in U.S., and contributed to groundwater-modeling activities for the high-level waste program.

DATES From: 1982 To: 1983

Groundwater Hydrologist, GCA Technology Div., Superfund consulting

(12) SIGNIFICANT RESEARCH or DEVELOPMENT ACCOMPLISHMENTS

My early work was basic research on groundwater flow and solute-transport modeling, which expanded to field method research in fractured-rock hydrology. After participating in the grad-school training program, I was re-assigned to the Pennsylvania Water Science Center (PaWSC) and worked on soft-funded applied research, mostly related to contamination in fractured rock. I was selected for a 4-year international assignment working on the 'water track' of the Middle East Peace Process. Returning to the PaWSC, I was asked to co-lead a multi-disciplinary team investigating chlorinated solvent fate in fractured rock for the Toxics program. Throughout this progression from basic research, to applied research, to scientific leadership (with a side-step in 'hydrology for peace'), I have focused on advancing methods for understanding groundwater flow and solute transport in fractured-rock settings.

a. RECENT ACCOMPLISHMENTS

Scientific leadership in fractured-rock contaminant hydrology

My work has transitioned from independent research towards leadership for multi-disciplinary research on flow and transport in fractured-rock aquifers. I co-coordinate research for the Toxics Program on Fate of Contaminants in Fractured Rock (P43, 45-47, 50-51, 56; A19-25, 28-34, 37-47, 49-50). This coordination includes several academic and private institutions in collaboration with USGS scientists. Project success is indicated by increased USGS stature in the fractured-rock remediation sector; increased USGS program funding and increased support from other federal agencies (EPA, DOD, and DOE) for USGS fractured-rock research. I was asked to serve on the 2013 EPA Science Advisory Panel on impacts of hydraulic fracturing on drinking water, and have been retained by DOE Oak Ridge for consultation on groundwater remediation strategic planning. With two colleagues, I was requested to provide guidance to EPA HQ on methods for evaluation of capture zones in fractured-rock aquifers. (A48)

Field and simulation methods for large-scale process understanding in fractured-rock aquifers

I am developing innovative field methods for characterizing contaminants in the rock matrix, and for in situ estimation of diffusion rates in fractured-rock aquifers. (A33, 37, 39, 41-42; manuscripts in preparation)

I continue to develop new modeling approaches for simulation of groundwater flow and

contaminant transport in fractured rocks, with support from EPA Superfund, Region III and the Pennsylvania Dept. of Environmental Protection (see previous accomplishments below), including research on uncertainty of advective flowpaths and accuracy of numerical model approaches (P54; A17, 27). I have applied new numerical methods to simulation of groundwater flow in flooded coal mines (P49, 52), and am evaluating large-scale groundwater depletion in Jordan's fractured-rock aquifers (P53)

b. OTHER CAREER ACCOMPLISHMENTS

I worked on water aspects of the Middle East Peace Process at the U.S. Embassy in Tel Aviv, Israel from 2000 to 2005. This resulted in maintenance of water sector cooperation between Israel and Palestine and Jordan during a difficult political period. (A26)

Developed GIS and preprocessor programming algorithms for modeling spatially variable dipping sedimentary beds in MODFLOW. Flexible approach allows strike and dip, and other structural properties, to vary in model domain, and nearly instantaneous re-gridding for local/regional scale simulations. (P38, 39, 54)

Used automatic model calibration methods to identify hydraulic properties of highly heterogeneous fractured rocks in Pennsylvania. Develop methods for calibration of a single regional-scale model using regional "water-table" data and local-scale aquifer and packer test data. Regional and local-scale models used to simulate contaminant migration pathways and pumping well captures zones. (P38)

Re-analyzed numerous aquifer test results to establish baseline for studies in Triassic Basin rocks important for water supply, and affected by industrial and military contamination. (P29)

Used flow modeling to support hypothesized increases in vertical hydraulic conductivity of confining units caused by largest earthquake measured in Pennsylvania. (P31)

Extended the MOC3D solute transport model to account for spatially and temporally variable sorption and decay reactions to approximate effects of contaminant attenuation processes. Incorporated terms in the transport equation for direct simulation of ground-water age, accounting for dispersion and other mixing processes. (P32, 33, 34)

I developed a new mathematical simulation method for groundwater age in aquifers. This work is widely cited and has been expanded by others (P24, P28).

Conducted field and modeling study of age-dating tracer CFC concentrations near the water table at the Mirror Lake NH fractured rock hydrology research. Preliminary results indicate that CFC-11 and CFC-113 are degraded completely very close to the water table in some anaerobic settings, and that CFC-12 is significantly degraded as well. Extensive field data collection and vadose zone monitoring will support modeling studies of CFC transport and fate in this complex glacial till/crystalline bedrock setting. (P28, 35)

Conducted modeling study of multi-phase CFC transport from atmosphere to the water table under nonisothermal conditions. Showed that CFC input function in humid environments is characterized by an equilibrium temperature higher than the annual mean due to a nonlinear Henry's Law coefficient as a function of temperature. Also showed that in arid environments this effect is mitigated by gaseous diffusion in the unsaturated zone. (P28)

Developed (with Konikow and Hornberger) MOC3D, an extension of the method-of-characteristics model of Konikow and Bredehoeft to 3D, linked with MODFLOW. An improved advection algorithm was developed. This model has been successfully applied by colleagues in WRD and academia. Developed most test cases and wrote major sections of USGS WRI documentation. (P20, 25)

Studied interblock transmissivity in finite-difference flow models and developed exact alternatives to the commonly used harmonic mean for different conceptual models of spatial variability. Showed that the harmonic mean is the least accurate of the means considered for cases with smoothly varying transmissivity. (P22) These algorithms (BCF3) were the only 'optional' package to be incorporated in the core MODFLOW-96 (Harbaugh and McDonald, 1996).

Developed a new analytical solution for concentrations in a pumping well for an initially stratified solute. This model was used to interpret radon during a pump test in fractured rock at Mirror Lake, yielding estimates of apparent fracture transport aperture. (P23)

Developed and calibrated a three-dimensional model of flow at Mirror Lake, NH, fractured rock research site. Used regression procedures to determine calibration targets from long-term, but non-uniformly populated, water-level database. Used novel automatic model calibration procedures to test alternative hydrogeologic models of this nonlinear flow system, and estimate large-scale hydraulic conductivity of fractured rock and glacial drift. (P27, 30)

Used manual and automatic flow model calibration to identify large-scale vertical and horizontal anisotropy using only head and streamflow observations (no prior information on anisotropy) in a sedimentary fractured rock formation. Application of the model for 1950's conditions shows that a widely used USGS water table map overestimates the effect of water-supply pumping on regional water levels. (P36)

Reexamined the theory of a widely used form of the two-dimensional transport equation and showed that numerous models contain an unacknowledged approximation for the case of transient flow. The effect of changing fluid storage during transient flow is not fully accounted for in these models, resulting in incorrect dilution volumes, velocities, dispersion coefficients, and concentrations. The correct formulation of the problem is easily implemented in existing programs. (P13, 21)

Compared two particle-tracking methods: velocity interpolation methods and a node-to-node routing scheme used in the literature. Proved that node-to-node routing introduces artificial dispersion, even for uniform flow, and illustrated the impact of this artifact on transport in a rock fracture and in highly heterogeneous porous media. (P18, 19)

Studied effects of transient flow on solute transport at the Idaho National Engineering Laboratory (INEL). Incorporating transient flow did not significantly improve model fit, but the newly calibrated dispersivities exhibit the theoretically expected feature of the longitudinal component being larger than the transverse component, in contrast to previous results. (P16)

(13) SCIENTIFIC AND PUBLIC SERVICE

a. CURRENT MEMBERSHIPS IN PROFESSIONAL SOCIETIES.

American Geophysical Union, Hydrology Section, since 1981.
Geological Society of America, Hydrogeology Division, since 1998.

b. TECHNICAL PRESENTATIONS

A1. "Evaluation of simplified techniques for prediction of moisture breakthrough in soil liners", Conf. on Mgmt. of Uncontrolled Haz. Waste Sites (Superfund), Washington DC, 1983. (P2) (PRESENTED)

A2. "Analysis of groundwater quality data near an active uranium ore processing mill", Symposium on Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Fort Collins CO, 1984. (P4, 9) (PRESENTED)

A3. "Selection of soils for wick effect covers", Symposium on Geotechnical and Geohydrological Aspects of Waste Disposal, Fort Collins CO, 1986. (P6) (PRESENTED)

A4. **Goode, D.J.**, 1987, Velocity interpolation schemes for advective transport in heterogeneous aquifers [abs.]: ***EOS, Transactions, American Geophysical Union***, in AGU 1987 Fall Meeting; v. 68, no. 44, November 3, 1987, p. 1290. (P12) (PRESENTED)

A5. **Goode, D.J.**, and Konikow, L. F., 1988, Can transient flow cause apparent transverse dispersion? [abs.]: ***EOS, Transactions, American Geophysical Union***, in AGU 1988 Fall Meeting, v. 69, no. 44, November 1, 1988, p. 1184-1185. (P15) (PRESENTED)

A6. **Goode, D.J.**, and Konikow, L. F., 1989, Can transient flow cause apparent transverse dispersion? [abs.], *in* Mallard, G. E., and Ragone, S. E., eds., U.S. Geological Survey Toxic Substances Hydrology Program--Proceedings of the technical meeting, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigation Report 88-4220, p. 644. (P15) (PRESENTED)

A7. "Reevaluation of large-scale dispersivities for a waste chloride plume: effects of transient flow", International Association of Hydrological Sciences Conference on Calibration and Reliability in Groundwater Modelling, The Hague, The Netherlands, 1990. (P16) (PRESENTED)

A8. "Testing a method-of-characteristics model of three-dimensional solute transport in ground water", Invited, International Symposium on Ground Water, National Conf. on Hydraulic Engineering, American Society of Civil Engineers, Nashville, 1991. (P20) (PRESENTED)

A9. **Goode, D.J.**, and Appel, C. A., 1992, Exact alternatives to harmonic mean for finite-difference interblock transmissivity [abs.]: ***EOS, Transactions, American Geophysical Union***, v. 73, no. 14, Spring Meeting Supplement, p. 123. (P22) (PRESENTED)

A10. "Concentration history during pumping from a leaky aquifer with stratified initial concentration", National Conference on Hydraulic Engineering, American Society of Civil Engineers, San Francisco, 1993. (PRESENTED) (P23)

A11. **Goode, D.J.**, 1994, Direct simulation of ground-water age [abs.]: ***EOS, Transactions, American Geophysical Union***, v. 75, no. 44, Fall Meeting Supplement, p. 231. (P24) (PRESENTED)

A12. **Goode, D.J.**, 1996, New type curves for estimation of aquifer properties from water-level recovery under Theis conditions: (abs.) p. S95 in 1996 Spring Meeting, supplement to Eos, 23 April 1996, American Geophysical Union, Washington DC. (P26) (PRESENTED)

A13. **Goode, D.J.**, Senior, L.A., and Amantia, Andrea, 1997, Aquifer tests and regional ground-water flow in fractured Triassic rock, Lansdale, Pennsylvania: (abs.) ***Geological Society of America Abstract with Programs***, vol. 29, no. 1, p. 49. (P36) **Invited**

A14. **Goode, D.J.**, 1997, CFC transport to and degradation near a shallow water table, Mirror Lake, Grafton County, New Hampshire: (abs.) in 1997 Spring Meeting, 28-31 May 1997, Baltimore MD. (P28) (PRESENTED)

A15. "CFC's in the unsaturated zone and in shallow ground water at Mirror Lake, New Hampshire" and at USGS Toxics Meeting, Charleston, S.C., 1999. (P35) (PRESENTED)

A16. "Modifications to the solute-transport model MOC3D for simple reactions, double porosity, and age, with application at Mirror Lake, New Hampshire, and other sites" at USGS Toxics Meeting, Charleston, S.C., 1999. (P34) (PRESENTED)

A17. **Goode, D.J.**, Lewis-Brown, J., Risser, D.W., and Senior, L.A., 2004, "Scale and Hydrogeologic Complexity in Models of Ground-Water Flow for Newark-Basin Aquifers", at Regional Workshop on Hydrogeology of the Newark Basin, Rutgers U., New Brunswick, N.J., 11-12 Nov 2004. (INVITED, PRESENTED)

A18. **Goode, D.J.**, 2005, Direct simulation of ground-water age, 2005 National Ground Water Association Theis Conference: Ground Water Age: Estimation, Modeling, and Water Quality Sustainability, September 23-26, Tahoe City, Calif. (INVITED, PRESENTED)

A19. **Goode, D.J.**, Tiedeman, C.R., Imbrigiotta, T.E., Lacombe, P.J., Best, E.W., Chapelle, F.H., Bradley, P.M., Shapiro, A.M., Révész, K.M., Johnson, C.D., Williams, J.H., Dale, J.M., 2006, Distribution and Fate of TCE in Fractured Sedimentary Rocks of the Newark Basin, NAWC, West Trenton, New Jersey (abs.): National Ground Water Association Focus Conference on Eastern Regional Ground Water Issues, Portland, Maine, September 2006. (PRESENTED)

A20. **Goode, D.J.**, Tiedeman, C.R., and Lacombe, P.J. (leaders), 2006, Geologic, hydrogeologic, and biogeochemical controls on natural and enhanced degradation of industrial solvents in fractured rocks: *Field Trip* at Geological Society of America 2006 Annual Meeting, 26 October 2006, Philadelphia, Pa. and West Trenton, N.J. (PRESENTED)

A21. **Goode, D.J.**, Tiedeman, C.R., Lacombe, P.J., Imbrigiotta, T.E., Chapelle, F.H., Bradley, P.M., Shapiro, A.M., Johnson, C.D., Williams, J.H., Révész, K.M., Burton, W.C., Ellefsen, K.J., and Dale, J.M., 2006, Distribution, transport, and biodegradation of TCE in fractured sedimentary rocks of the Newark Basin, NAWC, West Trenton, New Jersey (abs.): in ***Geological Society of America 2006 Annual Meeting***, 22-25 October 2006, Philadelphia. (INVITED, PRESENTED)

A22. Shapiro, A.M., Tiedeman, C.R., **Goode, D.J.**, Bradley, P.M., Chapelle, F.H., Imbrigiotta, T.E., Lacombe, P.J., Rosman, Robert, and Vroblesky, D.A., 2006, An innovative borehole apparatus for characterizing depth-dependent microbial activity and ground-water chemistry in fractured rocks at the Naval Air Warfare Center, West Trenton, NJ (abs.): in ***Geological Society of America 2006 Annual Meeting***, 22-25 October 2006, Philadelphia. (INVITED)

A23. Tiedeman, C.R., Lacombe, P.J., **Goode, D.J.**, 2006, Using aquifer test simulations to investigate hypotheses about ground-water flow in fractured sedimentary rocks at the Naval Air Warfare Center (NAWC), West Trenton, NJ (abs.): in Geological Society of America 2006 Annual Meeting, 22-25 October 2006, Philadelphia. (P47)

A24. Shapiro, A.M., Chapelle F.H., **Goode, D.J.**, Tiedeman, C.R., Lacombe, P.J., Imbrigiotta, T.E., Bradley, P.M., Révész, K.M., Johnson, C.D., Williams, J.H., Burton, W.C., Ellefsen, K.J., DeFlaun, M., and Lewandowski, R.F., 2006, Distribution, Transport, and Biodegradation of TCE, DCE, and Vinyl Chloride in Fractured Sedimentary Rocks at the Naval Air Warfare Center, West Trenton, NJ: Strategic Environmental Research and Development Program (SERDP) Workshop, November 28-30, 2006, Washington, DC

A25. Tiedeman, C.R., Bradley, P.M., Chapelle, F.H., **Goode, D.J.**, Imbrigiotta, T.E., Johnson, C.D., Lacombe, P.J., Révész, K.M., Shapiro, A.M., Williams, J.H., Dale, J.M., 2006, Transport and Attenuation study of TCE, DCE, and VC in Dipping Fractured Sedimentary Rock (abs.): The fifth International Battelle Conference: Remediation of Chlorinated and Recalcitrant Compounds: Conference May 22-25, 2006 Monterey, California.

A26. **Goode, D.J.**, Lenox, A.M., and Shampine, W.J., 2007, Middle East Water Data Banks and Public Awareness and Water Conservation Projects 1995-2004 (abs.): Geological Society of America Abstracts with Programs, v. 39, no. 6, p. 342. (INVITED, PRESENTED)

A27. **Goode, D.J.**, and Fan, Ying, 2007, Comparison of stair-step and dipping-layer approaches for simulation of flow and advective transport in fractured-sedimentary formations (abs.): in 2007 NGWA/U.S. EPA Fractured Rock Conference: State of the Science and Measuring Success in Remediation, September 24-26, 2007, Portland, Maine: National Ground-Water Association (CD-ROM), p. 517. (PRESENTED)

A28. **Goode, D.J.**, 2007, USGS research on fate and remediation of point-source NAPLs (abs.): EPA Region III States LUST Technical Workshop, October 22 - 24, 2007, Gettysburg, Pennsylvania. (INVITED, PRESENTED)

A29. Révész, K., Shapiro, A.M., Tiedeman, C.R., **Goode, D.J.**, Lacombe, P.J., and Imbrigiotta, T.E., 2007, Monitoring natural biodegradation of TCE by analyzing d13C of different compounds: National Ground Water Association, 2007 U.S. EPA/NGWA Fractured Rock Conference: State of Science and Measuring Success in Remediation(5017), September 24-26, 2007, Portland, Maine. (P56)

A30. **Goode, D.J.**, Imbrigiotta, T.E., Lacombe, P.J., Shapiro, A.M., and Tiedeman, C.R., 2008, Distribution of trichloroethene in a fractured-rock aquifer: Detection of pure phase, core measurements, diffusion into boreholes, and implications for pump-and-treat remediation (abs.): SERDP/ESTCP Partners in Environmental Technology

Technical Symposium and Workshop, December 2-4, 2008, Washington, DC. (PRESENTED)

A31. Révész, K., Shapiro, A.M., Tiedeman, C.R., **Goode, D.J.**, Lacombe, P.J., and Imbrigiotta, T.E., 2008, Using Carbon Isotopes to Monitor Natural Biodegradation of TCE in the Ground Water of Fractured Sedimentary Rocks Underlying the Former Naval Air Warfare Center West Trenton, New Jersey, SERDP, 2008, Washington, December (P56)

A32. Révész, K., Shapiro, A.M., Tiedeman, C.R., **Goode, D.J.**, Lacombe, P.J., and Imbrigiotta, T.E., 2008, Monitoring Natural Biodegradation of TCE in Fractured Sedimentary Rocks Using delta 13C of TCE and its Degradation Products: Estimating Isotopic Fractionation Factor under Field Conditions, AGU Fall Meeting, San Francisco, Dec 19 -25, 2008. (P56)

A33. **Goode, D.J.**, 2009, Persistence of separate phase, dissolved, and sorbed chlorinated solvents in fractured-rock aquifers: USGS Toxic Substances Hydrology Program National Point Source Research Meeting, held jointly with EPA Superfund Ground-Water Forum mtg., January 26-29, 2009, San Diego, California, (INVITED, PRESENTED)

A34. Révész, K., Shapiro, A.M., Tiedeman, C.R., **Goode, D.J.**, 2009, Monitoring d13C of TCE to evaluate microbial degradation, in a fractured sedimentary rock aquifer in New Jersey, USA : AIG -8 2009 (Eight Applied Isotope Geochemistry) La Malbaie, Quebec, Canada, August 30, 2009. (P56)

A35. **Goode, D.J.**, Cravotta, C.A. III, Hornberger, R.J., and Hewitt, M.A., 2010, Simulation of water-resources development of flooded coal mines in the Western Middle Anthracite Field, Pennsylvania (abs.): American Water Resources Association 2010 Annual Conference, Philadelphia, November 1-4, 2010. (P49) (PRESENTED)

A36. **Goode, D.J.**, Koerkle, E.H., Klipsch, J.D., and Shallcross, A.L., 2010, Modeling recent flooding in the Delaware River (abs.): American Water Resources Association 2010 Annual Conference, Philadelphia, November 1-4, 2010. (P48) (PRESENTED)

A37. **Goode, D.J.**, Imbrigiotta, T.E., Lacombe, P.J., Shapiro, A.M., and Tiedeman, C.R., 2010, Mass of trichloroethene and other contaminants in the rock matrix and estimates of diffusion coefficients and rates at the former Naval Air Warfare Center, West Trenton, N.J. (abs.): SERDP/ESTCP Partners in Environmental Technology Technical Symposium and Workshop, November 30 -- December 2, 2010, Washington, DC. (PRESENTED)

A38. Révész, K.M., Shapiro, A.M., Tiedeman, C.R., **Goode, D.J.**, Lacombe, P.J., and Imbrigiotta, T.E., 2010, Monitoring Natural Biodegradation of TCE in Fractured Sedimentary Rocks Using delta 13C of TCE and its Degradation Products: Estimating Isotopic Fractionation Factor under Field Conditions (abs.): American Geophysical Union Annual Meeting, San Francisco, 2010. (P56)

A39. Shapiro, A.M., **Goode, D.J.**, Tiedeman, C.R., Imbrigiotta, T.E., and Lacombe, P.J., 2010, Evaluating the removal of TCE from the rock matrix during bioaugmentation in fractured rock. (abs.): SERDP/ESTCP Partners in Environmental Technology Technical Symposium and Workshop, November 30 -- December 2, 2010, Washington, DC.

A40. Tiedeman, C.R., Shapiro, A.M., Lacombe, P.J., **Goode, D.J.**, Hsieh, P.A., and Imbrigiotta, T.E., 2010, Importance of hydrogeologic characterization to successful bioaugmentation of contaminated fractured sedimentary rocks (abs.): 2010 National Ground Water Assoc. Groundwater Summit Conf., April 11-15, 2010, Denver.

A41. **Goode, D.J.**, Imbrigiotta, T.E., and Shapiro, A.M., 2011, Field-scale borehole diffusion experiments at the former Naval Air Warfare Center, West Trenton, New Jersey (abs.): National Ground Water Assoc. Focus Conf. on Fractured Rock and Eastern Groundwater Regional Issues, September 26-27, 2011, Burlington, Vermont. (PRESENTED)

A42. **Goode, D.J.**, Imbrigiotta, T.E., Lacombe, P.J., Tiedeman, C.R., Walker, Steven, and Miller, M.A., 2011, Changes in distribution of trichloroethene and other contaminants in fractures and the rock matrix during bioaugmentation at the former Naval Air Warfare Center, West Trenton, N.J. (abs.): SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, Nov 30 - December 2, 2011, Washington, DC. (PRESENTED)

A43. Imbrigiotta, T.E., Drew, S.R., de Flaun, M.F., Kirshtein, J., Voytek, M.A., **Goode, D.J.**, Tiedeman, C.R., Shapiro, A.M., and Lacombe, P.J., 2011, Changes in chlorinated ethane concentrations, geochemistry, and microbiology due to bioaugmentation in a fractured sedimentary rock aquifer at the former Naval Air Warfare Center, West Trenton, NJ, 2008-2011 (abs.): SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, Nov 30 - December 2, 2011, Washington, DC.

A44. Lacombe, P., Shapiro, A., Chapelle, F., Imbrigiotta, T., **Goode, D.**, and Tiedeman, C., 2011, Unmonitored and monitored pump and treat, bioaugmentation, and natural attenuation, Naval Air Warfare Center, West Trenton, New Jersey, 1953-2011 (abs.): SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, Nov 30 - December 2, 2011, Washington, DC.

A45. Miller, M.A., Madden, A.S., Lacombe, P.J., Imbrigiotta, T.E., **Goode, D.J.**, Kendall, M.R., Blumenthal, J.S., and Wernette, S.J., 2011, Mineralogy and chlorinated solvent content of a Van Houten cycle in the Lockatong Formation, Newark basin, West Trenton, NJ (abs.): Clay Minerals Society's 45th Annual Meeting, September 24-29, 2011.

A46. Révész, K., Sherwood-Lollar, B., Shapiro, A.M., Kirshtein, J., Voytek, M., Imbrigiotta, T.E., Busenberg, E., Tiedeman, C.R., and **Goode, D.J.**, 2011, Use of light stable isotopes, dissolved gas constituents, and microbial community abundances to characterize biodegradation of chlorinated ethenes in a fractured-rock aquifer (abs.): Isotope Workshop XI, European Society for Isotope Research, 4-8 July 2011, Budapest. (P56) (KEYNOTE)

A47. Révész, K., Sherwood Lollar, B., Shapiro, A.M., Kirshtein, J., Voytek, M., Busenberg, E., Imbrigiotta. T.E., Tiedeman, C.R. and **Goode, D.J.**, Tracking the progress of bioaugmentation in the remediation of chlorinated ethenes in groundwater of fractured rock with stable isotopes of carbon and hydrogen, dissolved gas constituents and microbial communities. Geological Society of America Annual Meeting. Minneapolis, MN. Oct. 2011. (P56)

A48. Shapiro, A.M., **Goode, D.J.**, and Williams, J.H., 2011, Application of existing guidance, methods, and models for evaluating capture zones in fractured rock

aquifers (abs.): National Ground Water Assoc. Focus Conf. on Fractured Rock and Eastern Groundwater Regional Issues, September 26-27, 2011, Burlington, Vermont. (PRESENTED)

A49. Slater, L., Shapiro, A., Lane Jr., J.W., Lacombe, P., Johnson, C., Tiedeman, C., **Goode, D.**, Ntarlagiannis, D., and Robinson, J., 2011, Advancing the electrical geophysical characterization of DNAPL-contaminated fractured rock aquifers (abs.): SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, Nov 30 - December 2, 2011, Washington, DC.

A50. Tiedeman, C.R., Hsieh, P.A., Curtis, G.P., **Goode, D.J.**, and Lacombe, P.J., 2011, Importance of groundwater flow and nonreactive transport modeling to reactive transport simulations of remediation in contaminated fractured rocks at the former Naval Air Warfare Center, West Trenton, N.J. (abs.): SERDP/ESTCP Partners in Environmental Technology Technical Symposium & Workshop, Nov 30 - December 2, 2011, Washington, DC.

A51. **Goode, D.J.**, Cravotta III, C.A., and Risser, D.W., 2013, Groundwater budgets for coal-mine aquifers in the anthracite region of Pennsylvania (abs.): Pennsylvania Groundwater Symposium, May 8, 2013, State College, Pa. (P49, 52)

A52. "Groundwater", Workshop on Middle East North Africa Water Information System Platform – Morocco, NASA Goddard Space Flight Center, Greenbelt, Md., December 4, 2013. (INVITED)

A53. **Goode, D.J.**, Imbrigiotta, T.E., and Lacombe, P.J., 2014, Hydrostratigraphic controls on contaminant transport and retention in fractured mudstones of the Lockatong Formation of the Newark Basin (abs.): Northeastern Section, Geological Society of America, March 23-25, 2014, Lancaster, Pa.

A54. **Goode, D.J.**, Senior, L.A., and Risser, D.W., 2014, Streamflow depletion by groundwater pumping from fractured-rock aquifers of the Newark Basin (abs.): 2014 Pennsylvania Groundwater Symposium, May 7, 2014, State College, Pa.

A55. "Groundwater Mapping through the NASA WISP Project", Workshop on Tunisian Water and Livelihoods Initiative, USDA-ARS Hydrology Lab, Beltsville, Md., October 16, 2014. (INVITED)

c. RENDERING SCIENTIFIC JUDGMENT

Associate Editor, *Ground Water*, 1996-1998.

Review panel member (and "lead reviewer") for U.S. Agency for International Development, Middle East Regional Cooperation scientific research proposals, 2010.

Invited presentation for Federal Remediation Technology Roundtable on characterization methods for remediation of fractured rock, 2010.

Hydrology review team member for Salem PSEG nuclear power plant license application for U.S. Nuclear Regulatory Commission, 2011.

Consultation for Oak Ridge Reservation Site Specific Advisory Board on contaminant migration in fractured rock, 2012-present.

Member, U.S. Environmental Protection Agency, Science Advisory Board Review Panel on Hydraulic Fracturing Research, 2013-present.

Associate Editor, *Hydrogeology Journal*, 2014-present.

d. LECTURESHIPS AND OTHER ACADEMIC SERVICE

Post-doctoral advisor for A. Amantia, Dept. of Geology and Geophysics, University of Catania, Italy, on flow and transport modeling, 1994-95.

Courses

Drexel Univ., graduate course “Solute Transport Modeling” (with G.N. Paulachok), 1994.

Penn State - Great Valley, graduate course “Ground Water Modeling”, 1996.

Princeton, “Environmental and Civil Engineering Systems Planning and Design”, 1998, 1999.

Seminars

Virginia Tech, “Low-level radioactive waste and hydrology”, 1986.

Stanford University, “Fat plumes in transient groundwater flow”, 1991.

Princeton, “Transport in fractured rock”, 1993.

Princeton, “Parameter identification for ground-water models”, 1994.

Drexel University, “Modeling flow in fractured rock”, 1994.

Princeton, “Simulating ground-water age with a transport equation”, 1994.

Princeton, “CFC transport under nonisothermal conditions”, 1995.

Princeton, “Estimating aquifer properties from water-level recovery in wells”, 1996.

Princeton, “Field and modeling study of CFC transport and fate”, 1996.

Temple Univ., “CFC degradation and vadose zone processes at Mirror Lake, NH”, 1996.

University Catania, Italy, 5-day graduate level short course, “Ground-water flow and transport modeling”, 1996.

Dickinson College, “Tracer Test in Fractured Rock”, field laboratory, 1998.

Drexel University, "Ground water flow in fractured sedimentary rocks in Pennsylvania: Model applications and earthquake effects", 1999.

e. TECHNICAL TRAINING PROVIDED

Four 1-day courses for U.S. EPA staff on “Ground-Water Flow and Transport Modeling” (with L.F. Konikow) in Philadelphia, Atlanta, Chicago, and Kansas City, 1988.

“Modeling Transport of Ground-Water Solutes”, USGS National Training Center (with L.F. Konikow), 1989, 1992, 1995, 1998.

Taught (with L.F. Konikow) a short course on ground-water flow and solute transport modeling for Florida Dept. of Environmental Regulation, 1990.

“Use of New MODFLOW Modules and Related Programs for Ground-Water-Flow Modeling in the Northeast”, USGS workshop, Marlborough MA, 1993.

“Introduction to Ground-Water Flow and Transport Modeling”, Pennsylvania Dept. Environmental Protection, Harrisburg, 1997.

“Ground-Water Transport Modeling with MOC3D”, USGS workshop, Lemoyne, Pa., 1997.

“Approximating attenuation processes in ground water using simple, flexible reactions in MOC3D”, USGS Ground-Water Modeling Workshop on Optimization and Reactive-Solute Transport, Including Natural Attenuation, Baltimore, 1999.

"Direct Age Simulation - Theory and Application", 1999 USGS National Ground-Water Meeting, Denver.
"Evaluating Capture Zones in Fractured-Rock Aquifers" (with A.M. Shapiro and J.H. Williams), U.S. EPA Tech. Support Project Workshop, Orlando, 2010.
"Trend Analysis of Groundwater Levels", Ministry of Water and Irrigation, Amman, Jordan, 2011.
"Advances in fluid flow and solute transport in fractured rocks" (with P.A. Hsieh), 2012 USGS National Groundwater Meeting, Denver.
"Salinity Trends Analysis and Well Data Mapping using GIS", Ministry of Water and Irrigation, Amman, Jordan, 2012.
"Characterizing contaminant mass in the rock matrix" (with T.E. Imbrigiotta), 2014, USGS / EPA Region 2 Fractured Rock Workshop, New York, NY.

f. SPECIAL ASSIGNMENTS

Water Cooperation in the Middle East
From August of 2000 to August of 2004, I served as the U.S. Regional Coordinator for the Water Data Banks project, a regional effort under the Multilateral Working Group on Water Resources, Middle East Peace Process. Although stationed at the embassy in Tel Aviv, I was also accredited as a U.S. diplomat to Jordan, and regularly visited the West Bank and Gaza. In planning, organizing, and implementing numerous projects, I represented the U.S. government to Israeli, Palestinian and Jordanian officials, and provided hydrologic expertise to the respective embassies, and the U.S. consulate in Jerusalem. These efforts were significant in maintaining and strengthening U.S. contributions to the Middle East Peace Process during a difficult political period (the "2nd Intifada"). In addition to leadership on the technical Water Data Banks project, I served as U.S. Regional Coordinator for the WaterCare and RainCatcher projects under the Public Awareness and Water Conservation components of the Water Working Group. More information about these activities can be found at the following web sites: EXACT (exact-me.org); WaterCare (watercare.org); USGS international projects web site (http://international.usgs.gov/regional/regmideast.htm)

g. OTHER TECHNICAL ACTIVITIES

EXACT, 2006, Application of methods for analysis of rainfall intensity in areas of Israeli, Jordanian, and Palestinian interest: Executive Action Team, Middle East Water Data Banks Project, ISBN 0-16-076155-7, 31 p. [http://exact-me.org/ri/rain2/] (I was lead report compiler and coordinator of the multilateral "Rainfall Intensity II" project.)
EXACT, 2006, Application of methods for analysis of rainfall intensity in areas of Israeli, Jordanian, and Palestinian interest, Supplement: Radar analysis of rainfall intensity in the Mujib basin: Executive Action Team, Middle East Water Data Banks Project, 6 p. [http://exact-me.org/ri/rain2/]
EXACT, 2006, Hydrogeologic databases in areas of Israeli, Jordanian, and Palestinian interest: Executive Action Team, Middle East Water Data Banks Project, 2 p. [http://exact-me.org/EXACT%20-

%20HydroGeo%20Data%20base%20summary.pdf] (I was lead report compiler and coordinator of the multilateral “Hydrogeologic Databases” project.)

(14) TECHNOLOGY AND INFORMATION TRANSFER AND DISSEMINATION

- Member of USGS Pennsylvania Water Science Center Web Page Redesign Team, 2011.
- Webmaster for USGS Toxic Substances Hydrology Program research at the former Naval Air Warfare Center, West Trenton, NJ, public and intranet web sites, 2005 to present.

(15) HONORS, AWARDS, RECOGNITION, ELECTED MEMBERSHIPS

- Chi Epsilon Civil Engineering National Honorary Society, 1980
- Arthur T. Ippen Fellowship (travel funds), MIT, 1982
- High Quality Increase for Outstanding Performance, US Nuclear Reg. Comm., 1985
- Special Achievement Award, USGS/WRD, 1991
- USGS Water Resources Div. Graduate School Training Program, 1993
- Special Achievement Award, USGS/WRD, 2005, for Middle East work
- Dept. of Interior Superior Service Award, 2009

See publications online at profile.usgs.gov/djgoode