ROBERT M. POWELL

SENIOR PROJECT SCIENTIST/SENIOR PROJECT MANAGER

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Note: A detailed project addendum to this curriculum vita is available upon request or by download at http://dl.dropbox.com/u/2200852/RMPowell_CV_Addendum.pdf

Selected Career Highlights

- Eleven years as an analytical geochemist, 11 years leading environmental research, 13 years of environmental consulting.
- Instrumental in permeable reactive barrier research and development, with numerous publications and reports for U.S. EPA.
- Researched, developed and authored methods of low-flow and passive purging and sampling of ground water.
- Researched and authored about the mechanism of facilitated transport of contaminants on colloids and as organic complexes in ground water.
- Member of the External Advisory Group for the Water Quality and Hydrology Group (ESH-18) of Los Alamos National Laboratory for seven years.
- Expert witness on various court cases, including alleged industrial soil contamination, improperly installed monitoring wells, etc., for industrial clients.
- Identified causes and sources of sediment toxicity in Michigan's Manistee Lake, using exploratory data analysis, for the Little River Band of Ottawa Indians.
- Serving (currently) as an expert consultant on Lake Michigan's Bay Harbor Cement Kiln Dust Release Site for the Little Traverse Bay Bands of Odawa Indians.
- Peer and proposal reviewer for several journals and agencies, including Environmental Science & Technology, the Journal of Contaminant Hydrology, and the Journal of Hazardous Materials; the Strategic Environmental Research and Development Program (SERDP, U.S. DOD) and the Small Business Innovative Research Program (SBIR, U.S. EPA).

Career Overview

- Restarted Powell & Associates Science Services, September 2011 to present.
- Senior Project Scientist/Senior Project Manager, Horizon Environmental Corp., Detroit/Troy, MI, from January 2006 to September 2011.
- Owner, Powell & Associates Science Services for eight years, an environmental consultancy with expertise in surface and ground water, sediments and soils.

- Researcher at the U. S. EPA's National Risk Management Research Laboratory, Robert S. Kerr Environmental Research Center, Ada, OK, for 11 years.
- Chemist at the Oklahoma Geological Survey, University of Oklahoma, for 11 years.
- 36 years of achievement in environmental science and chemistry, including 37 scientific publications with more than 50 presentations, abstracts, and posters for scientific meetings and innumerable project reports for clients.

EDUCATION

M.S. Environmental Science, University of Oklahoma, Norman OK, 1994.
Thesis*: Geochemical Effects on Chromate Reduction and Remediation Utilizing the Thermodynamic Instability of Zero-Valence-State Iron*
B.S. Zoology, University of Oklahoma, Norman OK, 1980.

EMPLOYMENT HISTORY

Horizon Environmental Corporation	Senior Project Scientist/Senior Project Mgr.	2006-2011
Powell & Associates Science Services	Owner/Project Scientist	1997-2011
ManTech Environmental Research Svcs. Corp., Ada, OK (at U.S. EPA)	Project Scientist & QA Coordinator	1986-1997
Oklahoma Geological Survey	Analytical Chemist	1975-1986
University of Oklahoma, Zoology	Research Assistant	1974-1975

PROFESSIONAL SUMMARY

I am now Senior Scientist/Owner of Powell & Associates Science Services. I was most recently a Senior Project Scientist and Senior Project Manager at the Southeast Michigan operations of Horizon Environmental Corporation in Troy, MI, having joined the company in January 2006. I have over 36 years of continuous scientific and technical achievement in environmental science, chemistry, ground water, surface water, soils, sediments, and the subsurface.

Before joining Horizon, I operated the consulting company Powell & Associates Science Services (PASS) for nine years. Prior to that, I spent 11 years performing subsurface research and ground water investigations at the Robert S. Kerr Environmental Research Center (RSKERC) of the U.S. EPA National Risk Management Research Laboratory (NRMRL), serving as a QA/QC coordinator while actively doing environmental research. Before the RSKERC I worked for 11 years at the Oklahoma Geological Survey, University of Oklahoma, as an analytical chemist working with both aqueous and solid-phase environmental media. I have 24 years of research and consulting experience on the transport, fate, sampling, assessment and remediation of metals, inorganic and organic chemicals in soils, sediments, the subsurface and water. I have authored at least 37 publications, book chapters, and encyclopedia articles, given more than 52 presentations, posters and abstracts for meetings, and prepared countless reports.

During my education and career, I have acquired knowledge and expertise through my work in a number of areas, including:

- Performing R&D, writing publications, and doing consulting on low-flow rate and passive purging and sampling techniques, methods now used worldwide to obtain ground water

samples, as well as on innovative in situ technologies such as contaminant remediation using permeable reactive barriers, the bioremediation or redox-sensitive metals, electrically enhanced bioactive barriers and others

- Addressing the transport, fate, sampling and remediation of metals, inorganic and organic chemicals in the subsurface, including contaminant partitioning onto mobile colloids, surface charge effects, and metal-organic complexation in waters, soils, and sediments.
- Making recommendations for environmental programs and projects related to assessments of surface water, soil, sediment, and ground water contamination, including site characterization, environmental studies and action plans relative to both technical and political issues
- Elucidating chemical mechanisms and doing geochemical modeling involving the interactions of soils, sediments, contaminants and water to assess contaminant transport and fate that considers factors such as contaminant and matrix interfacial interactions and mechanisms of facilitated contaminant transport, such as:
    - Metal partitioning onto mobile soil/sediment colloids and surface charge effects on colloidal interfacial interactions,
    - Metal-organic complexes and their interactions with water, soil, aquifer materials and organic carbon, and
    - Plume effects on aquifer materials and contaminant immobilization/release.
- Using exploratory and inferential statistical analyses (EDA) on complex data from both field sites and laboratory experiments to find hidden trends, unexplained data anomalies, and pinpoint causes, such as assessing contaminant sources, discerning liability, characterizing landfill leachates, and to separate storage from WMU areas at RCRA sites.
- Developing economic comparisons of remediation technologies
- Doing and enhancing laboratory analytical techniques including both wet chemistry and instrumentation
- Supervising and managing scientists, technicians and students
- Proposal writing and reviewing
- Program and project management and review, including workflow and progress evaluations, QA/QC, safety, and the supervision of scientists, engineers, technicians and students
- Coordinating/facilitating interactions between diverse management groups (corporate, government, tribal, contractor, legal, stakeholder) regarding environmental programs
- Evaluations of environmental impacts with regard to proposed locations of industrial processes, zoning and special use permits
- Expert witness testimony on several cases

<u>Narrative Examples:</u>

- ✓ Since coming to Horizon I have served as an expert witness on complex soil contamination cases, developed a sampling plan for a lake and its sediments for a tribal government, reviewed and advised on a large Brownfields cement kiln dust site having leachate impacts on Lake Michigan for another tribal government, evaluated several sites for both characterization and remediation approaches using EDA, assessed the design and planned implementation of a novel subsurface permeable reactive barrier for a state government, developed sampling guidance for combustion of recycled input materials to a large industrial client to reduce fossil fuel consumption, provided chemistry support on the volatilization of organic compounds and

the emissions calculations for air modeling of a volatile pesticide release, and facilitated and managed many other projects, including NPDES review, development and oversight.

- ✓ While a PASS consultant and owner, I served for seven years as a member of the External Advisory Group (EAG) for the Water Quality and Hydrology Group (ESH-18) of the Los Alamos National Laboratory (LANL) to address their contaminant and ground water issues, as well as providing a broad range of environmental products to other clients (additional project details for this period and all others are in my CV Addendum). One role of the EAG at LANL was to provide liaison between LANL, DOE, the New Mexico Environment Department, the New Mexico Attorney's General office, the Native American Pueblos and a diverse group of other environmental stakeholders. Other PASS clients included U.S. EPA, EPRI, the Little River Band of Ottawa Indians, RPS Consultants, Sewell Environmental, Dynamac Corporation, ManTech Environmental, Applied Hydrogeologic Research, SCS Engineers, Snohomish Co., WA, and Natural Resource Technology, Inc.

- ✓ I implemented original research as the Principal Investigator on numerous subsurface and groundwater research projects at the RSKERC NRMRL of U. S. EPA. I supervised scientists and students carrying out laboratory and field research on these projects and directed the analytical requirements. I designed the experiments, developed the workplans and project budgets, successfully maintained the projects within these budgets, met QA and safety requirements, and always achieved the goals and milestones. Milestones included the production of reports for U.S. EPA and peer-reviewed journal articles. I served as Quality Assurance Coordinator for ManTech. My responsibilities included reviewing and approving all project plans, quality assurance documents, reports and other outputs prior to submission to the U.S. EPA. My work at the RSKERC is chronicled in my publications list, below. I received several accomplishment awards from U.S. EPA and ManTech Environmental for my work, which included published research on the techniques for low-flow rate and passive purging and sampling of ground water. I studied the facilitated transport of metals in the subsurface by synthesizing radioactive spherical hematite particles and performing tracer studies through soil columns saturated with ground water to determine the conditions for enhanced transport of arsenic adsorbed to the colloidal iron oxide surfaces. My research on permeable reactive barriers elucidated reaction rates and the geochemical mechanisms by which certain metals (e.g., Cr^{6+}) are reduced and immobilized by PRB systems in the subsurface. This information was incorporated into the concept, design and construction of the permeable reactive barriers at Elizabeth City, NC, and others.

- ✓ I served as an Analytical Chemist at the Oklahoma Geological Survey (OGS) chemistry laboratory. My laboratory experience covered the entire range of operations from sample preparation of soils, coal, mineral and water samples and performing wet chemistry through the use of all OGS' analytical instruments. I was the OGS scientist who could carry out every aspect of every procedure in the analytical laboratory. I improved laboratory data handling by writing seven programs for the PDP11/03 computer that automated the data analysis and performed QA/QC checks via techniques such as mass and ion balances. I participated in the design of custom software to improve instrument control and data analysis using the ARL 35000 sequential inductively coupled spectrometer. Responsibilities included method development, quality control, report writing, computer programming, supervision, and analyses. I performed analyses of environmental materials using all available instruments, but also using a broad spectrum of wet chemistry procedures. I was the expert at the State of Oklahoma on the analysis of coal and coal ash. I served as the coordinator for the OGS hazardous waste compliance operations, operating as an interface between the OGS and the

University of Oklahoma programs. I supervised and trained students, technicians, and chemists.

- ✓ During my career I have been active in the operation of small service companies, notably Powell & Associates Science Services (former owner), Great Plains Laboratories (former President), and Powell & Associates Analytical Services (former owner). These companies provided analytical methods and training to consultants, hospitals, and industry; also specialty chemical analyses of water, oilfield brines, paints, solder, and failed aircraft components.

I am also, by education, interest and certain experience, well trained in biology, particularly in the areas of physiology, evolution, and ecology.

In the realm of public service, I served as interim Mayor, 1985-86, for the Town of Slaughterville, OK, having been appointed by Oklahoma Governor George Nigh following resignation of the previous board.

Awards and Honors

- President's Award for Excellence, 1995, ManTech Environmental Technology, Inc.
- Scientific and Technological Achievement Award, Level III, U. S. Environmental Protection Agency, 1996
- Two-time winner of the Performance Incentive Program Award, ManTech Environmental Technology, Inc.

Publications and Presentations

My journal articles and reports include the following, selected to show my range of experience, with more than 50 unlisted presentations, posters, and abstracts for meetings.

37. Powell, R.M. "*Exploratory Data Analysis: Reality-Based Results For Defensible Science and Litigation Support.*" Paper 435. Proceedings of the 2009 (102nd) A&WMA Annual Conference. Detroit, MI.

36. Powell, R. M., Pugh, J., and B. Hensel. 2007. "*Groundwater Remediation of Inorganic Constituents at Coal Combustion Product Management Sites, Technology Review*." Electric Power Research Institute Report 1012584.

35. Powell, R.M. 2005. "*Techniques for Ground Water Sampling.*" Invited chapter for the Environmental Instrumentation and Analysis Handbook. John Wiley & Sons, Inc., New York. Down, R.D. and J. Lehr, eds. pp. 1068.

34. Powell, R.M. and R.W. Puls. 2003. "*Technology Update: Current Status of the Practice for Permeable Reactive Barrier Technology Applications.*" U.S. EPA Report for Issue Paper.

33. Powell, R.M., Powell, P.D., and R.W. Puls. 2002. "*Economic Analysis of the Implementation of Permeable Reactive Barriers for Remediation of Contaminated Ground Water*." U.S. EPA. EPA/600/R-02/034. June 2002.

32. Puls, R.W., Powell, R.M., Paul, C.J., and D.W. Blowes. 1999. "*Ground Water Remediation of Chromium Using Zero-Valent Iron in a Permeable Reactive Barrier: Laboratory and Field Study*

Results." Chapter 13 in ACS Symposium Series 725, Innovative Subsurface Remediation, Field Testing of Innovative Remediation Technologies. pp. 182-194.

31. Powell, R.M., Puls, R.W. 1998. "*Natural Attenuation of Arsenic.*" U.S. EPA Report for Issue Paper.

30. Powell, R.M., Shen, H., and G.W. Sewell. 1998. "*Bioattenuation of Redox-Sensitive Metals*." U.S. EPA Report for Issue Paper.

29. Powell, R.M., Puls, R.W., Blowes, D., Vogan, J., Gillham, R.W., Powell, P.D., Schultz, D., Landis, R., and T. Sivavec. 1998. "*Permeable Reactive Barrier Technologies for Contaminant Remediation.*" U.S. EPA Report. EPA/600/R-98/125.

28. Puls, R.W., Powell, R.M., and C.J. Paul. 1998. "*Contaminant Reduction and Remediation Using Zero-Valent Iron in Permeable Reactive Subsurface Barriers: Reactions, Geochemical Effects, and Pilot-Scale Field Studies.*" U.S. EPA Report for Environmental Research Brief.

27. Powell, R.M. and P.D. Powell. 1998. "*Iron Metal for Subsurface Remediation.*" Invited chapter for The Encyclopedia of Environmental Analysis and Remediation. Robert A. Myers, ed. John Wiley & Sons, Inc., New York. 8:4729-4761.

26. Powell, R.M. and R.W. Puls. July 1997. "*Permeable Reactive Subsurface Barriers for the Interception and Remediation of Chlorinated Hydrocarbon and Chromium (VI) Plumes in Ground Water.*" U.S. EPA Remedial Technology Fact Sheet. EPA/600/F-97/008.

25. Powell, R.M. and R.W. Puls. 1997. "*Proton Generation by Dissolution of Intrinsic or Augmented Aluminosilicate Minerals for In Situ Contaminant Remediation by Zero-Valence-State Iron.*" Environmental Science & Technology. 31:2244-2251.

24. Powell, R.M. and R.W. Puls. June 1997. "*Hitting the Bull's-Eye in Groundwater Sampling.*" Cover Article, Pollution Engineering. 50-54.

23. Caughey, M.E., Barcelona, M.J., Powell, R.M., Cahill, R.A., Gron, C., Lawrenz, D., and P.L. Meschi. 1995. "*Interlaboratory Study of a Method for Determining Nonvolatile Organic Carbon in Aquifer Materials.*" Environmental Geology. 26:211-219.

22. Powell, R.M., Puls, R.W., Hightower, S.K., and D.A. Sabatini. 1995. "*Coupled Iron Corrosion and Chromate Reduction: Mechanisms for Subsurface Remediation.*" Environmental Science and Technology. 29:1913-1922.

21. Puls, R.W., Powell, R.M., and D.A. Clark. 1994. "*Assessment of Colloidal Transport in Ground Water, Pinal Creek Basin, Arizona.*" Chapter C in Hydrology and Geochemistry of Aquifer and Stream Contamination Related to Acidic Water in Pinal Creek Basin near Globe, Arizona. U.S. Geological Survey Water-Supply Paper, AZ082-745. 12/1/94. Brown, J. G. & B. Favor, eds.

20. Powell, R.M. 1994. "*Geochemical Effects on Chromate Reduction and Remediation Utilizing the Thermodynamic Instability of Zero-Valence-State Iron.*" Thesis, University of Oklahoma, Norman, OK.

19. Powell, R.M., Puls, R.W., and C.J. Paul. 1994. "*Chromate Reduction and Remediation Utilizing the Thermodynamic Instability of Zero-Valence-State Iron.*" Water Environment Federation Specialty

Conference Series, Innovative Solutions for Contaminated Site Management. March 6-9. Miami, FL.

18. Powell, R.M. and R.W. Puls. 1993. "*Passive Sampling of Ground Water Monitoring Wells Without Purging: Multilevel Well Chemistry and Tracer Disappearance*." Journal of Contaminant Hydrology. 12:51-77.

17. Puls, R.W. and R.M. Powell. 1992. "*Acquisition of Representative Ground Water Quality Samples for Metals.*" Invited paper. Ground Water Monitoring Review, Summer.

16. Puls, R.W., Powell, R.M., Clark, D.A., Bledsoe, B.E., and C.J. Paul. 1992. "*Metals in Ground Water: Sampling Artifacts and Reproducibility"*, Hazardous Waste, Hazardous Materials. 9(2):149-162.

15. Puls, R.W. and R.M. Powell. 1992. "*Transport of Inorganic Colloids Through Natural Aquifer Material: Implications for Contaminant Transport.*" Environmental Science and Technology. 26(3):614-621.

14. Puls, R.W., Powell, R.M., Clark, D.A., and C.J. Eldred. 1991. "*Effects of pH, Solid/Solution Ratio, Ionic Strength, and Organic Acids on Pb and Cd Sorption on Kaolinite.*" Water, Soil, and Air Pollution. 57-58:423-430.

13. Puls, R.W., Powell, R.M., Clark D.A., and C.J. Paul. July 1991. "*Facilitated Transport of Inorganic Contaminants in Groundwater: Part 2. Colloidal Transport.*" U.S. EPA Environmental Research Brief. EPA/600/M-91/040.

12. Puls, R.W. and R.M. Powell. 1991. "*Electrostatic Repulsive Effects on the Mobility of Inorganic Colloids in Subsurface Systems.*" Chapter 4 in Contaminant Transport in the Subsurface-Colloids and Surfactants, the 65th Annual Colloid and Surface Science Symposium, American Chemical Society. June 17-19. Sabatini, D. A. and R. C. Knox, eds. University of Oklahoma, Norman, OK.

11. Puls, R.W., Powell, R.M., and T.F. Rees. 1991. "*Stability and Transport of Inorganic Colloids Through Contaminated Aquifer Material.*" Proceedings of the Fifth Annual Toxic Substances Hydrology Technical Meeting. March 11-15. Monterey, CA.

10. Puls, R.W. and R.M. Powell. 1990. "*Laboratory Studies on the Stability and Transport of Inorganic Colloids Through Natural Aquifer Material.*" Concepts in Manipulation of Groundwater Colloids for Environmental Restoration. Oct. 16-18. Manteo, NC.

9. Puls, R.W., Eychaner, J.H., and R.M. Powell. 1990. "*Colloidal-Facilitated Transport of Inorganic Contaminants in Groundwater: Part 1. Sampling Considerations.*" U.S. EPA Environmental Research Brief. EPA/600/M-90/023.

8. Powell, R.M. 1990. "*Total Organic Carbon Determinations in Natural and Contaminated Aquifer Materials, Relevance and Measurement.*" Proceedings of the Fourth National Outdoor Action Conference on Aquifer Restoration, Ground water Monitoring And Geophysical Methods. National Water Well Association. May 14-17. Las Vegas, NV.

7. Powell, R.M., Bledsoe, B.E., Johnson, R.L., and G.P. Curtis. 1989. "*Interlaboratory Methods Comparison for the Total Organic Carbon Analysis of Aquifer Materials.*" Environmental Science and Technology. 23:1246-1249. (Reviewed in The Groundwater Newsletter. 18(19):2. 1989)

6. Powell, R.M., Kampbell, D.H., Bledsoe, B.E., Callaway, R.W., Michalowski, J.T., Vandegrift, S.A., White, M.V., and J.T. Wilson. 1988. "*Comparison of Methods to Determine Oxygen Demand for Bioremediation of a Fuel Contaminated Aquifer.*" International Journal of Environmental Analytical Chemistry. 34:253-263.

5. Armstrong, J.M., Korreck, W., Leach, L.E., Powell, R.M., Vandegrift, S.A., and J.T. Wilson. 1988. "*Bioremediation of a Fuel Spill: Evaluation of Techniques for Preliminary Site Characterization.*" Proceedings of the National Water Well Association Petroleum Hydrocarbons Conference. Nov. 9-11. Houston, TX.

4. Bouchard, D.C., Powell, R.M., and D.A. Clark. 1988. "*Organic Cation Effects on the Retention of Metals and Neutral Organic Compounds on Aquifer Material.*" Journal of Environmental Science and Health, Part A - Environmental Science and Engineering. 23(6):585-601.

3. Powell, R.M. 1988. "*Method Comparison for the Analysis of Total Organic Carbon in Waters and Soils Utilizing the Oceanographics International Ampule Analyzer, Leco Carbon Determinator, and Dohrmann Carbon Analyzer.*" Northrop Technical Report. TR-4410-87-17.

2. Bouchard, D.C., Powell, R.M., and D.A. Clark. 1987. "*Alkyl Ammonium Cation Effects on Aquifer Material Sorptivity.*" Agronomy Abstracts. p.166.

1. Powell, R.M. 1987. "*Changes in Volumetric Glassware after Heating at 565°C for Carbon Removal.*" EPA Quality Assurance Newsletter. 9(1).

An addendum detailing my professional experience, specific projects, certifications, computer/software familiarity, etc., is available immediately upon request or by download at http://dl.dropbox.com/u/2200852/RMPowell_CV_Addendum.pdf