MGWA Fall Conference 2010
Speaker Biographies

Peter B. McMahon, U.S. Geological Survey, Denver

Characterizing Redox Conditions in Groundwater: Approaches and Examples

Talk summary: This presentation will examine (1) basic redox concepts, (2) why redox is important to understanding many problems in groundwater chemistry, (3) methods for determining redox processes in groundwater, and (4) examples of how redox has been used to address real-world water-quality problems.

Pete is a Research Hydrologist with the U.S. Geological Survey. He spent the first 8 years of his USGS career in the South Carolina Water Science Center in Columbia and the past 18 years in the Colorado Water Science Center in Lakewood. He has degrees in geology from the University of Missouri, University of Texas, and University of South Carolina. Currently, Pete is Project Manager of the High Plains Regional Groundwater Study and Lead Scientist for the Piceance Basin Water Resource Assessment.

David Vinson, Duke University

New insights on Naturally-Occurring Radium in the Jordan Aquifer of Minnesota

Bullet points describing the research highlights:

- Untreated water from about 1/3 of Jordan sandstone aquifer wells sampled in southeastern Minnesota exceeds maximum contaminant level of 5 picocuries per liter radium-226+radium-228.
- The highest radium levels in the Jordan aquifer occur in the Twin Cities metropolitan area and in a narrow north-south corridor from Minneapolis to Medford.
- We document geologic and geochemical controls on radium, including the uranium levels of aquifer cuttings and the saturation state of barium sulfate.
- Geographic patterns of radium levels and the radium-228/radium-226 ratio distinguish the radium source in the Jordan aquifer from radium in the underlying Mt. Simon-Hinckley sandstone aquifer

PhD Candidate, Duke University, Division of Earth & Ocean Sciences, Durham, N.C.
BS, University of Alabama, 2000
MS, University of New Mexico, 2002
At Duke since 2006

Sharon Kroening (MPCA), Constance Holth (MDA)
MPCA and MDA Ambient Monitoring Program Activities

- Overview of MPCA ambient groundwater quality monitoring network
- MPCA Network Enhancements
- Access to water-quality data information
- Concluding remarks

- Statutory Requirements
- Goals and Objectives of MDA Monitoring Program
- MDA Historical and Current Groundwater Monitoring in Minnesota
- Monitoring Network Design
- Dissemination of Information

Sharon Kroening, Minnesota Pollution Control Agency

Education
M.S. (Civil Engineering), University of Minnesota, 1994
B.S. (Chemistry), University of Minnesota, 1990

Experience
2007-present, Minnesota Pollution Control Agency (research scientist)
2000-2007, US Geological Survey—Florida (hydrologist)
1994-2000, US Geological Survey—Minnesota (hydrologist)

Affiliations
Minnesota Groundwater Association (MGWA)
National Groundwater Association (NGWA)

Constance Holth, Minnesota Department of Agriculture
Education
B.S (Environmental Geology & Technology), University of North Dakota, 1995

Experience
1996-1997, American Crystal Sugar Company (Research Scientist)
1998–Present, Minnesota Department of Agriculture (Hydrologist)

Affiliations
Minnesota Ground Water Association

Scott F. Korom, University of North Dakota

Geologic Processes Linking Electron Donors and Aquifers: Implications for Minnesota

- Fundamentals of denitrification and the role of electron donors
- Potential sources of electron donors
- Examples of aquifers with electron donors, particularly with respect to denitrification
- Implications for Minnesota and the region

Education
Ph.D. Utah State University (Civil & Environmental Engineering), 1992
M.S. University of Akron (Civil Engineering), 1984
B.S. University of Akron (Civil Engineering), 1982

Experience
1994-present, Department of Geology & Geological Engineering, University of North Dakota
1992-1994, Department of Energy Postdoctoral Research Fellow, Savannah River Site, Aiken, SC

Affiliations
American Geophysical Union (AGU)
American Society of Civil Engineers (ASCE)
National Ground Water Association (NGWA)

Brandy M. Toner, University of Minnesota

State-of-the-Science Tools for Measuring Arsenic Speciation in Glacial Sediments

- The speciation concept: why it matters for arsenic
- The challenge: a trace element and a contaminant
- The approach: X-ray absorption spectroscopy for composite materials
- Micron-scale heterogeneity: Taking advantage of complexity

Education
Ph.D. (Env. Science, Policy, and Management), University of California - Berkeley, 2004
M.S. (Civil and Environmental Engineering), University of California - Berkeley, 1999
B.S. (Environmental Studies/Hydrogeology), Bemidji State University, 1997

Experience
2008-present, University of Minnesota (Assistant Professor)
2007-2006, Woods Hole Oceanographic Institution (NASA Postdoctoral Fellow)
2006-2005, Woods Hole Oceanographic Institution (National Research Council Associate)

Affiliations
Mineralogical Society of America
American Chemical Society
American Geophysical Union

Michael Russelle, USDA-ARS

Leaves it Cleaner Than They Found It: Perennial Forages and Water Quality

- Perennial forage root growth, water use, and nitrate uptake
- Reducing ground water nitrate
- Protecting surface water quality
- Potential role in nitrate TMDLs for cold water streams

Education
Ph.D. (Agronomy), University of Nebraska-Lincoln, 1982
M.S. (Crop Science), Oregon State University, 1978
B.S. (Agronomy), Oregon State University, 1976

Experience
1995-present Adjunct Professor, Dept. of Soil, Water, & Climate, University of Minnesota
1982-present Research Soil Scientist, USDA-ARS, Plant Science Research Unit, St. Paul, MN

Affiliations
Soil Science Society of America (Fellow)
Soil and Water Conservation Society
American Society of Agronomy (Fellow)
Minnesota Association of Professional Soil Scientists
Midwest Forage Association
Sigma Xi

Carl J. Rosen, University of Minnesota

*Strategies for Reducing Nitrate Leaching from Irrigated Potato Productio*n

- Potato production in Minnesota
- Specific potato production factors contributing to nitrate leaching
- Best management practices identified that reduce nitrate leaching
- Challenges involved - Case study in Perham, MN
- General conclusions and long-term solutions

Education
Ph.D. (Soil Science), University of California, Davis, 1983
M.S. (Horticulture), Pennsylvania State University, 1978
B.S. (Horticulture), Pennsylvania State University, 1976

Experience
2010- present, Professor and Head, University of Minnesota, Department of Soil, Water, & Climate
1995-present, Professor, University of Minnesota, Department of Soil Water, and Climate
2007-2008, Interim Associate Dean for Extension, University of Minnesota, CFANS
2002-2003, Interim Head, University of Minnesota, Department of Horticultural Science
1989-1995, Associate Professor, University of Minnesota, Department of Soil Science
1983-1989, Assistant Professor, University of Minnesota, Department of Soil Science

Affiliations
Soil Science Society of America
American Society of Agronomy
American Society for Horticultural Science
Potato Association of America

Luke Stuewe, Minnesota Department of Agriculture

A Practical Application of Perennial Crops in Wellhead Protection: Park Rapids, MN

- Park Rapids groundwater nitrate trends/history
- Engaging area landowners
- The addition of a perennial crop into an irrigated rotation
- Important factors in this process

Education
M.S. (Water Resource Science) UMN-St. Paul, 2006 B.S. (Watershed Management) UW-Stevens Point, 2003 A.S. (Hydrology) Vermilion Community College, 2000

Experience
2006-Present (Water Quality Advisor) MN Department of Agriculture
2003-2005 (Research Assistant) UMN-St. Paul, Water Resources Science Program
1999-2003 (Hydrologic Technician) USGS-Mounds View, MN

Tim Cowdery/ Rich Soule

Nitrate Loading and Fate in Shallow Groundwater near Cold Spring, MN

Tim Cowdery, U.S. Geological Survey, Mounds View
Tim is a hydrogeologist with the U.S. Geological Survey in Mounds View, Minnesota. He currently serves as a chief for several projects at the Water-Science Center in Minnesota. He earned a master's degree from the University of Minnesota in groundwater geology in 1997. His research interests include groundwater/surface-water interactions, numerical groundwater modeling, and groundwater recharge analysis.

Rich Soule, Minnesota Department of Health
Rich is a registered geologist in the Wellhead Protection unit at MDH. His prior convictions include risk assessment and evaluation at MDH, and two counts of consulting with Geraghty & Miller and Barr Engineering. He has a B.A. in Geology from Carleton College and a masters in Civil Engineering from the U of M. Should he continue like this, he is likely to earn his third strike and be indefinitely incarcerated by a PhD.

Dave Legvold, Farmer/Educator (with an assist from Rebecca Spur, St. Olaf College)
Rethinking a Nitrogen Budget from the Standpoint of a Cheap Norwegian Farmer

Brief points in presentation:

- significant changes in tillage impact nutrient and sediment transport
- using manure as a nutrient source
- placing nitrate for maximum plant uptake efficiency
- challenges in placing nutrient in strip till regime
- tile water as a management challenge
  - water level structures
  - wood chip bio-reactors
  - infiltration/holding structures
- Is fall nitrate placement a good idea in the Karst Region of SE MN?
- Economics of nitrate efficiency and manure use.

Dave is a Minnesota farm kid, born and raised on a dairy farm near Northfield. He is a retired teacher, having spent 35 years in the Richfield Schools teaching environmental science and a variety of other disciplines. He worked for the John Deere Company for 8 years, was Education Director at Eagle Bluff Environmental Learning Center and was most recently Executive Director of the Cannon River Watershed Partnership. He is now looking for quiet days in retirement but no such luck as he continues to farm 800 acres, serves on the Land and Legacy Amendment's Water Sustainability Framework Citizen Advisory, makes numerous appearances as "SEWERMAN!", as well as working to teach others about the possibilities and benefits of conservation agriculture.

MGWA Fall Conference Poster Session

Comparison of the Soil-Water Balance and Groundwater Recharge Among Annually-Harvested Perennial and Annual Biofuel Crops

Jared Trost
Hydrologist, United States Geological Survey
Mounds View, MN
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The transport of land-applied fertilizer to groundwater is a major environmental concern, especially in regions of coarse textured soils with shallow unconfined aquifers. The downward movement of water through soil is the primary mechanism by which contaminants are transported to groundwater. Previous research has shown that non-harvested perennial vegetation established on fine-textured soils significantly reduces groundwater recharge compared to annual corn. However, little research has been done to compare the soil water balance of annually-harvested perennial and annual crops grown on coarse-textured soils. A plot-scale field experiment was conducted over 18 months, encompassing two growing seasons, to compare the soil-water balance, groundwater recharge, and bromide tracer transport underlying four annually-harvested crop types: well-established perennial prairie, newly-established perennial hay, annual corn (*Zea mays*), and bare soil. Over the entire study period, perennial prairie compared to annual corn (1) extracted more soil water earlier in the growing season, (2) lost slightly more water to evapotranspiration (73.9 cm compared to 69.1 cm), (3) slightly reduced groundwater recharge (37.9 cm compared to 40.2 cm), and (4) retained the bromide tracer in the soil profile longer. Mass calculations for one plot per treatment showed less than 1 percent of the applied bromide leached below the rooting zone of prairie compared to 34 percent for corn and hay and 100 percent for bare soil. Bromide was only detected in groundwater underlying two of five replicate prairie plots and was detected in all five replicates of all other treatments. The center of mass of the bromide remaining in the soil at the end of the study period was 110 cm below land surface for prairie and hay and lower than 225 cm below land surface for both corn and bare ground. The difference in recharge between annual and perennial crops mentioned above is not as large as has been observed in previous studies and likely results from (1) the annual removal of litter which reduced rainfall interception and (2) low available water capacity of the soil. Annually-harvested well-established prairies on coarse soils reduced the movement of water and solutes to groundwater. Perennial prairies grown on marginal soils offer a strategy to both produce biofuel and buffer shallow groundwater from land applied fertilizers.

This collaborative research effort between the University of Minnesota's Cedar Creek Ecosystem Science Reserve and the United States Geological Survey (USGS) was funded by the Legislative Citizen Commission on Minnesota Resources (LCCMR) and the USGS Cooperative Water Program.

Determining Hydraulic Conductivity and
Avoiding Nitrate Contamination from Larger SSTS

Mark Wespetal and Gretchen Sabel
Minnesota Pollution Control Agency, Municipal Division
Subsurface Sewage Treatment Systems

Subsurface Sewage Treatment Systems (SSTS, also known as septic systems) treat wastewater from homes, businesses and institutions across Minnesota. By design, SSTS use the soil to polish and disperse treated septic tank effluent. A zone of dry soil beneath the bottom of the effluent dispersal area must be maintained for this polishing, and the soil must have adequate transmissivity to accept the amount of effluent delivered above it. Recent changes to the SSTS rules require SSTS designed for wastewater flows between 5000 and 10,000 gallons per day be designed and monitored to ensure that the dry soil zone is maintained when the site is in operation. MPCA has developed design guidance for SSTS professionals to use to determine hydraulic conductivity and design these larger SSTS to maintain unsaturated flow. Designs for these systems must also ensure that nitrate levels in the receiving aquifers do not violate the drinking water standard of 10 mg/l. The MPCA approach for ensuring this will also be presented. These approaches have been shared with professional geoscientists working with wastewater, MPCA would appreciate input from a broader audience at this conference.

Preliminary Assessment of Chemical Evidence for Recent Recharge to the
St. Peter-Prairie du Chien-Jordan Aquifer System

Jim Lundy
Minnesota Department of Health

Interest in assessing recharge to drinking water aquifers surges because recharge is an essential factor for accurate assessment of water availability, sustainability, wellhead protection, aquifer vulnerability, and contaminant transport (Scanlon and others, 2002; Delin and Falteisek, 2007; Lorenz and Delin, 2007). Existing studies of recharge in southeastern Minnesota assessed the "Decorah Edge" effect near Rochester, where the subcrop limit of the Decorah Shale creates a recharge boundary to the underlying bedrock aquifer. Groundwater flow modeling (Lindgren, 2000) showed flow paths undergoing significant upgradient movement when traversing the Decorah Edge and into the St. Peter aquifer. In map view, the modeled St. Peter "backwash" zone was approximately 1 km wide.

Implications are: 1) apparent geologic protection afforded beneath the Decorah footprint may not preclude recent recharge to the aquifer below, especially within about 1 km of the edge; and 2) there is an upgradient aquifer extent (> ~1 km of the edge) occupied by older flow paths, lacking recent recharge.

These implications may be testable using available chemical data. MDH mined existing datasets and devised a simple rubric that determines likelihood of recent recharge, based on presence and/or concentration of: nitrate; tritium; dissolved oxygen; chloride; and certain anthropogenic compounds. The resulting map closely mimics the earlier flow modeling, confirming a zone beneath the Decorah but near its edge, where recent recharge occurs in the underlying aquifer. Predicting the width of this zone where geologic protection does not prevent recent recharge would be useful for water management efforts in southeastern Minnesota.

References
Delin, G.N. and Falteisek, J.D., 2007, *Ground-water recharge in Minnesota*, United States Geological Survey Fact Sheet 2007-3002.

Lindgren, Richard J., 2000, *Ground-water recharge and flowpaths near the edge of the Decorah-Platteville-Glenwood confining unit, Rochester, Minnesota*, United States Geological Survey Water-Resources Investigations Report 00-4215, 41 pp.

Lorenz, D.L., and Delin, G.N., 2007, *A regression model to estimate regional ground water recharge*, Ground Water, vol. 45, no. 2, pp. 196-208.

Scanlon, B.R., Healy, R.W., and Cook, P.G., 2002, *Choosing appropriate techniques for quantifying groundwater recharge*, Hydrogeology Journal, vol. 10, pp. 18-39.

Requirements Under the New MPCA Industrial Stormwater Permit

Ross L. Ohman
Bay West, Inc, St. Paul

The new Minnesota Pollution Control Agency (MPCA) Industrial Stormwater Permit became effective on April 5, 2010 and many industrial companies and manufacturing facilities are unaware of its requirements and the consequences for non-compliance. The focus of the poster presentation will be to summarize these new MPCA stormwater permit requirements.

The goal of the new MPCA Industrial Stormwater Permit is to reduce the amount of pollution that enters surface and ground water from industrial companies in the form of stormwater run-off. This goal is accomplished through requiring certain industrial companies to apply for and comply with the new MPCA Industrial Stormwater Permit. The permit has many requirements from collecting stormwater samples to developing an effective Stormwater Pollution Prevention Plan (SWPPP) containing effective Stormwater Control Measures also known as Best Management Practices (BMPs). Regulated companies are required to manage stormwater run-off by complying with these new MPCA Industrial Stormwater Permit requirements.

All phases of permit compliance from application to benchmark monitoring, sample collection techniques, and packaging and testing will be presented. In addition, important considerations including “what not to do” will be covered in this presentation.