Improved Hydrogeologic Characterization of the Prairie du Chien Group

Bob Tipping
Minnesota Geological Survey

N.H. Winchell School of Earth Sciences
University of Minnesota
HYDROGEOLOGY OF THE PALEOZOIC BEDROCK IN SOUTHEASTERN MINNESOTA

Anthony C. Runkel
Minnesota Geological Survey

Robert G. Tipping
Minnesota Geological Survey

E. Calvin Alexander, Jr.
Department of Geology and Geophysics
University of Minnesota

Jeffrey A. Green
Minnesota Dept. of Natural Resources
Rochester

John H. Mosler
Minnesota Geological Survey

Scott C. Alexander
Department of Geology and Geophysics
University of Minnesota

Report of Investigations 61
ISSN 0076-9177

University of Minnesota
Saint Paul — 2003

Funding:
Legislative Commission on Minnesota Resources
Minnesota Board of Water Resources
Metropolitan Council
City of Rochester
"State Special" base funding through the University of Minnesota
Reasons for the study...

• Paleozoic bedrock aquifers in Minnesota have been commonly characterized as homogeneous and isotropic porous media.

• Technological advances in borehole geophysics allow measurements to be made showing the importance of secondary flow features.

• Can aquifer heterogeneity be mapped at a regional scale?
This talk...

• Present borehole study involving video, packer tests, water chemistry profiles and flowmeter measurements.

• Discuss geologic history of the Prairie du Chien Group and its impact on porosity and permeability.

• Discuss geologic models of the Prairie du Chien Group – past, current and future work at MGS.
C.

Logged borehole

Water enters hole, travels down

Water exits hole

Flowmeter

- - 0 +
Casing bottom

Consistent upflow along upper part of open hole and into casing (water exits higher in casing)

Water exits abruptly at two thin intervals of secondary pores separated by confining unit

Consistent, relatively strong upflow past confining unit

Water enters abruptly at three thin intervals of secondary pores and travels downhole. Entrances are separated by confining units.

Consistent upflow past confining unit

Water enters through intergranular pores and travels uphole

No measurable flow
Figure ____ General model of karst development along a subareally exposed carbonate platform (in Mazzulo and Chilingarian, 1996, modified from Choquette and James, 1988.)
B. gamma (natural)

Shakopee Fm.
Oneota Fm.
Oneota, Coon Valley Mbr.
Jordan Ss.

Depth below and surface (meters)

0 100 200

14 19 24

K1 K2 K3 K4 K5 K6

Borehole flow
ambient station measurements
(liters/min)

-4 0 4 8 12 16

-10 -5 0 5 10

downflow upflow
downflow upflow
Conclusions

• We recognize the importance of high permeability zones and fracture flow in understanding groundwater movement and recharge.

• Geologic models are moving beyond the identification of stratigraphic boundaries.

• Our ability to capture essential hydrogeologic characteristics in a geologic model will improve as computer capacity increases.