

## Geohydrology of Fractured Crystalline Rock of Northern Georgia

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**Cooperator** Coweta County, Forsyth County, Oconee County, Rockdale County, Troup County  
**Year Started** 2007

### Problem

Ground-water development and use in the fractured crystalline rocks of northern Georgia are critical to sustain population growth and economic development. Knowledge about ground-water movement, storage, vulnerability, quality, and connection with surface-water resources is limited because of the complexity of fractured-rock aquifers that underlie the region. A better understanding of the relation between the complex geology and ground-water resources in these areas is needed for water-resource managers and planners to develop effective management strategies and optimize available supply for future use.

### Objectives

The primary objective is to evaluate the occurrence and quality of ground water in fractured crystalline rock of the Piedmont and Blue Ridge physiographic provinces of northern Georgia. Specific objectives are to

- Compile existing information on geology and wells.
- Conduct a field inventory of existing wells to verify construction, yield, and location.
- Collect borehole geophysical and flowmeter logs to determine depth, yield, and geologic and water-quality characteristics of water-bearing intervals.
- Evaluate geologic, well, and borehole geophysical data to identify geologic settings favorable for the development of sustainable water supplies.
- Establish a ground-water-level monitoring network for northern Georgia.
- Develop and maintain a comprehensive geohydrologic database of well and geophysical data.

This investigation provides information to help guide future ground-water development and water-management decisions for local communities while enhancing understanding of the hydrogeology of fractured rocks in the southern Piedmont and Blue Ridge physiographic provinces. Data from this study are entered into the USGS National Water Information System (NWIS) and are available on the Web at <http://waterdata.usgs.gov/ga/nwis/inventory/>.

### Progress and Significant Results, 2006–2007

**Coweta County**—Developed plan of study to include well inventory and borehole geophysical logging in selected wells.

**Forsyth County**—Collected borehole geophysical logs and conducted borehole flowmeter traverse in two wells located



along the Chattahoochee River north of Little's Ferry Bridge. Developed plan of study for well-inventory program.

**Oconee County**—Collected borehole geophysical logs, grab water samples, and conducted borehole flowmeter traverse in two wells near the town of Watkinsville to evaluate causes of water-quality problems in the well water. In one well, dissolved carbon dioxide was being emitted; water in the other well was contaminated by iron bacteria.

**Troup County**—Completed compilation of data and field well inventory. Data for 138 wells were added to the existing 79-well NWIS database, which increased the total to 217 wells. Developed spatial hydrological data layers for wells and surficial geology. Began preparation of final report.

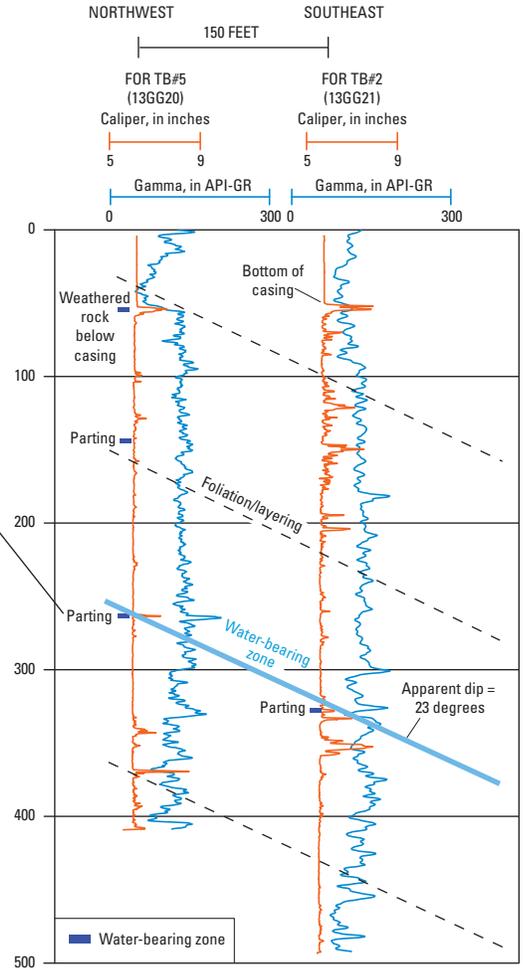
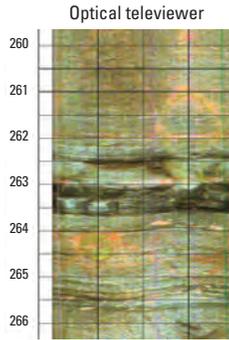
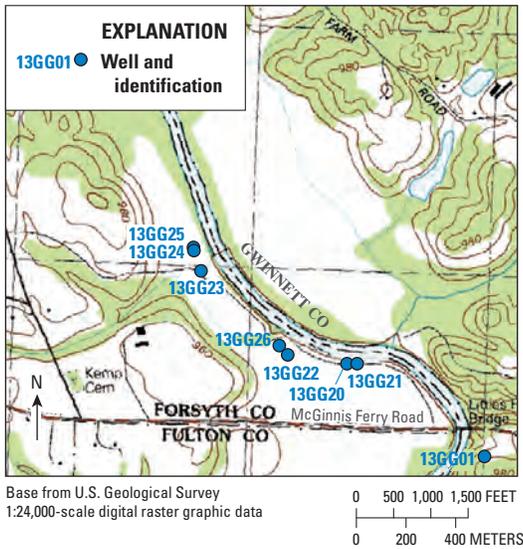
**Rockdale County**—Collected borehole geophysical logs in two test wells located adjacent to production wells in the Conyers area to determine structural orientations of fractures and bedrock foliation. This information was used to help assess the interconnection between test wells and production wells as a follow-up to aquifer testing conducted during 2005 (Williams and Cressler, 2007).

**Other areas**—In addition to the efforts in each of these counties, borehole geophysical logs were collected at several other sites in the Piedmont and Blue Ridge Provinces, including two wells in White County, one well in Habersham County, and one well in Madison County.

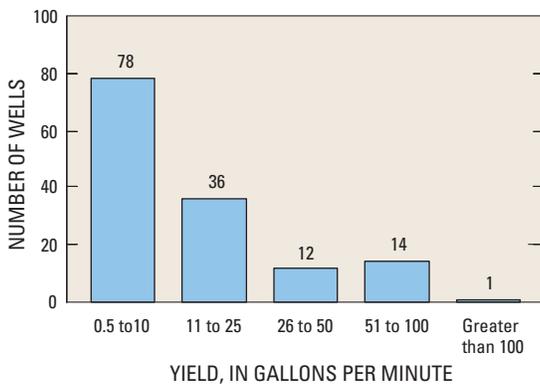
**Outreach**—Prepared a Fact Sheet describing how borehole geophysical logs can provide valuable information to evaluate ground-water resources in fractured crystalline rock (U.S. Geological Survey, 2007). The Fact Sheet describes the types of data collected and how these data are used to evaluate the water-bearing characteristics of fractured crystalline rock. See <http://pubs.usgs.gov/fs/2007/3048/>.

### References

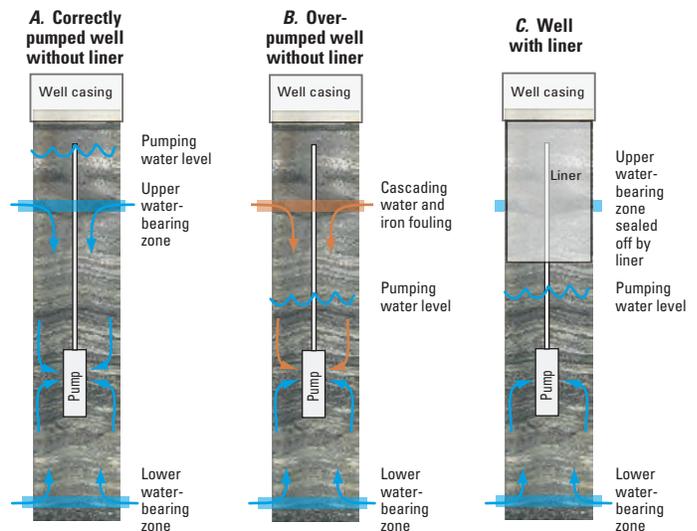
- Williams, L.J., and Cressler, A.M., 2007, Regional effect of pumping ground water from deep fracture systems in the Conyers area, Rockdale County, Georgia, in Proceedings of the 2007 Georgia Water Resources Conference, March 27–29, 2007: Athens, Georgia, The University of Georgia; available on the Web at [http://ga.water.usgs.gov/publications/gwrc07/pdf/Williams\\_Cressler\\_GWRC07.pdf](http://ga.water.usgs.gov/publications/gwrc07/pdf/Williams_Cressler_GWRC07.pdf).
- U.S. Geological Survey, 2007, Borehole geophysical logging of water-supply wells in the Piedmont, Blue Ridge, and Valley and Ridge, Georgia: U.S. Geological Survey Fact Sheet 2007–3048, 4 p.; Web-only publication available at <http://pubs.usgs.gov/fs/2007/3048/>.



Borehole geophysical logs collected in two wells in Forsyth County, Georgia, demonstrate the relation between geology and productive water-bearing zones in the wells. The caliper log indicates areas of voids in the borehole, such as fractures. The optical televiewer log shows an image of the rock and structure of the borehole. A flowmeter traverse conducted in well 13GG20 indicates water-bearing zones at 52, 143, and 263 feet (ft), with the 263-ft zone producing about 68-percent of the total yield. The 263-ft water-bearing zone is indicated by a larger well diameter on the caliper log and a dark void on the optical televiewer log. Structural measurements derived from borehole data indicate that water-bearing intervals are parallel to rock foliation at about a 23-degree dip angle. Projecting this dip angle from well 13GG20 eastward 150 ft indicates that the same water-bearing zone occurs at a depth of about 323 ft in well 13GG21. Interconnection of this zone between the two wells was also indicated by a 20-ft water-level response in well 13GG21 during pumping of well 13GG20.



In Troup County, a well inventory conducted during 2007 indicated that well yields vary greatly across the county ranging from 0.5 to more than 150 gallons per minute (gal/min). Of the wells inventoried, 97 had estimated yields from 0.5 to 25 gal/min, 13 wells from 26 to 50 gal/min, 14 wells from 51 to 100 gal/min, and 1 well with an estimated yield of 150 gal/min. There seems to be potential for development of high-yielding wells because 28 of the wells had yields of 26 gal/min or greater. The majority of the wells in the county probably were located based on convenience in relation to a home or business. A combination of detailed geologic mapping, well inventory, and geophysical logging can increase the probability of drilling a high-yielding well.



Borehole geophysical logs enable characterization of ground-water resources in fractured crystalline rock. These cross sections are excerpted from USGS Fact Sheet 2007-3048 and demonstrate how geophysical logs can be used to detect and prevent water-bearing zones from being exposed in the open portion of the borehole: (A) shows a correct pumping water level, (B) shows an over-pumped well without a liner, and (C) shows a liner that seals off shallow-water zones. The Fact Sheet can be accessed on the Web at <http://pubs.usgs.gov/fs/2007/3048/>.