VIRGINIA'S CONTRIBUTIONS TO THE NATIONAL GEOTHERMAL DATA SYSTEM

NGDS National Geothermal Data System

DMME Virginia Department of Mines Minerals and Energy

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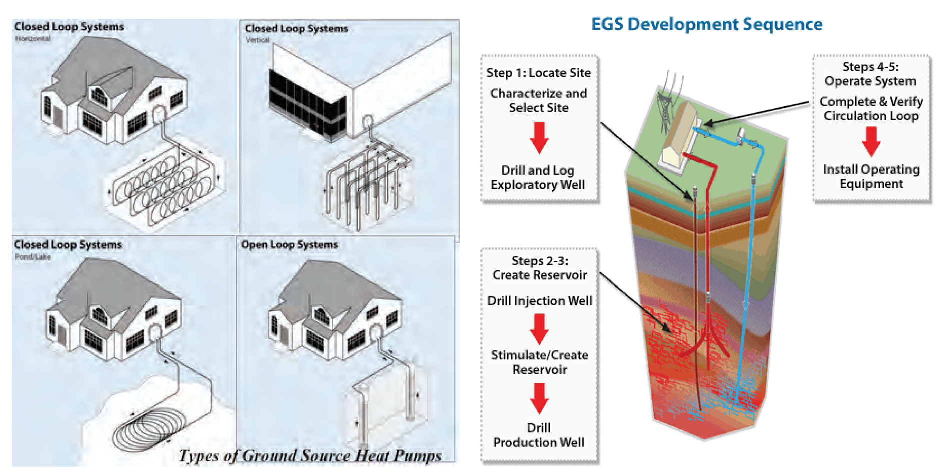
GEOTHERMAL ENERGY is the heat contained within the earth – a clean, reliable, and renewable energy. The heat energy is contained in normal occurrences of subsurface groundwater, which is transported to the surface of the earth by pumping. It can be used as an energy-efficient heating and cooling alternative for residential, commercial, and industrial applications, and is potentially a significant resource for electrical power generation in some regions of the United States.

Geothermal resources previously studied in the Appalachian Mountain System and the Atlantic Coastal Plain have been grouped into four types:

I. Water-saturated sediments of low thermal conductivity overlying radioactive heat-producing granites
II. Areas of normal geothermal gradient
III. Hot and warm springs emanating from fault-fracture zones as a result of leakage from greater depths
IV. Hot dry rock, especially radioactive granites beneath sediments of low thermal conductivity (Costain, et al., 1982)

Principal means of geothermal energy production in the eastern United States have been found to be low- to moderate-temperature fluids that are best suited for:

- Heat Pump (loop) Technology - low-temperature, highly efficient ground-source heat that can be extracted to cool homes in the summer and heat them in the winter
- Direct use of low- to moderate-temperature water (68°F to 302°F) for homes, industry and commercial uses
- Enhanced Geothermal Systems – deep engineered reservoirs requiring the addition of water, potentially nationwide at depths of 19,000 to 25,000 feet (6 to 8km)



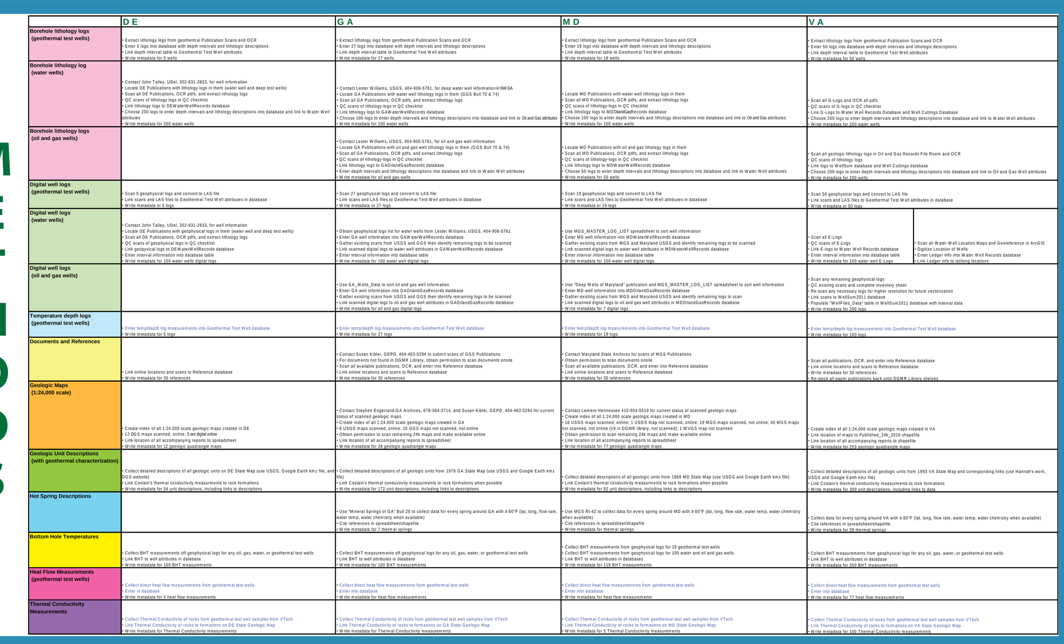
STATE GEOTHERMAL DATA

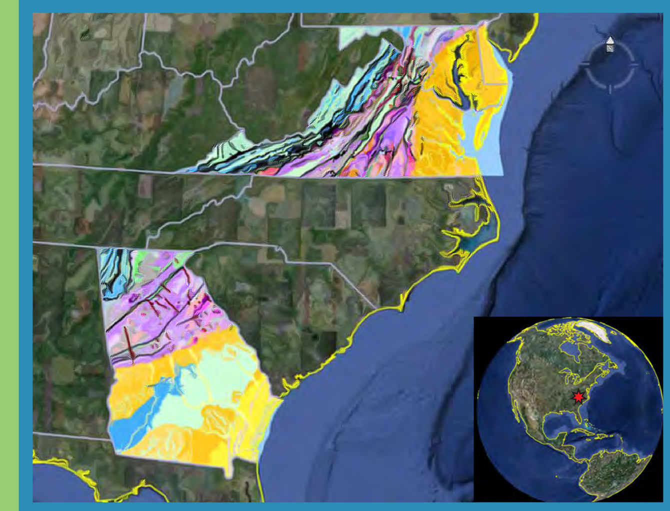
The Virginia Division of Geology and Mineral Resources (DGMR) participates in the National Geothermal Data System (NGDS), a U.S. Department of Energy-funded distributed network of databases for the acquisition, management and maintenance of geothermal and related data. Through a DOE grant that is administered by the Arizona Geological Survey (AZGS), Virginia along with other state geological surveys contributes data in the form of ***metadata*** to the NGDS. The objective of this ***3-year project*** is to populate, expand and enhance the NGDS by creating a national sustainable, distributed, interoperable network of predominantly state geological survey-based data providers that will develop, collect, serve and maintain geothermal relevant data that operates as an integral compliant component of NGDS. The DGMR Geothermal Program will contribute to the NGDS by gathering relevant data from **Virginia** and the nearby states of **Maryland**, **Delaware**, and **Georgia**.

The broad and diverse suite of data needed for effective exploration and development of geothermal energy resources are largely in analog form and must be digitized and tagged with metadata before submittal to NGDS. Listed below is a summary of data that will be submitted to the NGDS:

- **Borehole Lithology Logs** – descriptions of well cuttings and/or core from water, oil and gas, and geothermal wells
- **Hot Springs** – descriptions, flow data, water temperature and water chemistry when available
- **Geophysical Well Logs** – from water, oil and gas, and geothermal wells, including calculated temperature gradients
- **Bottom-hole Temperatures** – from geophysical logs from water, oil and gas, and geothermal wells
- **Temperature Depth Logs** – from geothermal test wells
- **Heat Flow Measurements** – from geothermal test wells
- **Thermal Conductivity Measurements** – from borehole samples from geothermal test wells
- **Existing Digital Databases** – Water Well Record Archives, Oil and Gas Well Database, Virginia Geologic Information Catalog
- **Geologic Maps** – detailed 1:24,000 scale, made available online as scanned images or in digtial format
- **Geologic Unit Descriptions** – including geothermal characterization from thermal conductivity measurements
- **Online Publications** – relevant references and citations

M E T H O D S





Geothermal Test Wells of Virginia

Virginia Tech Geothermal Program

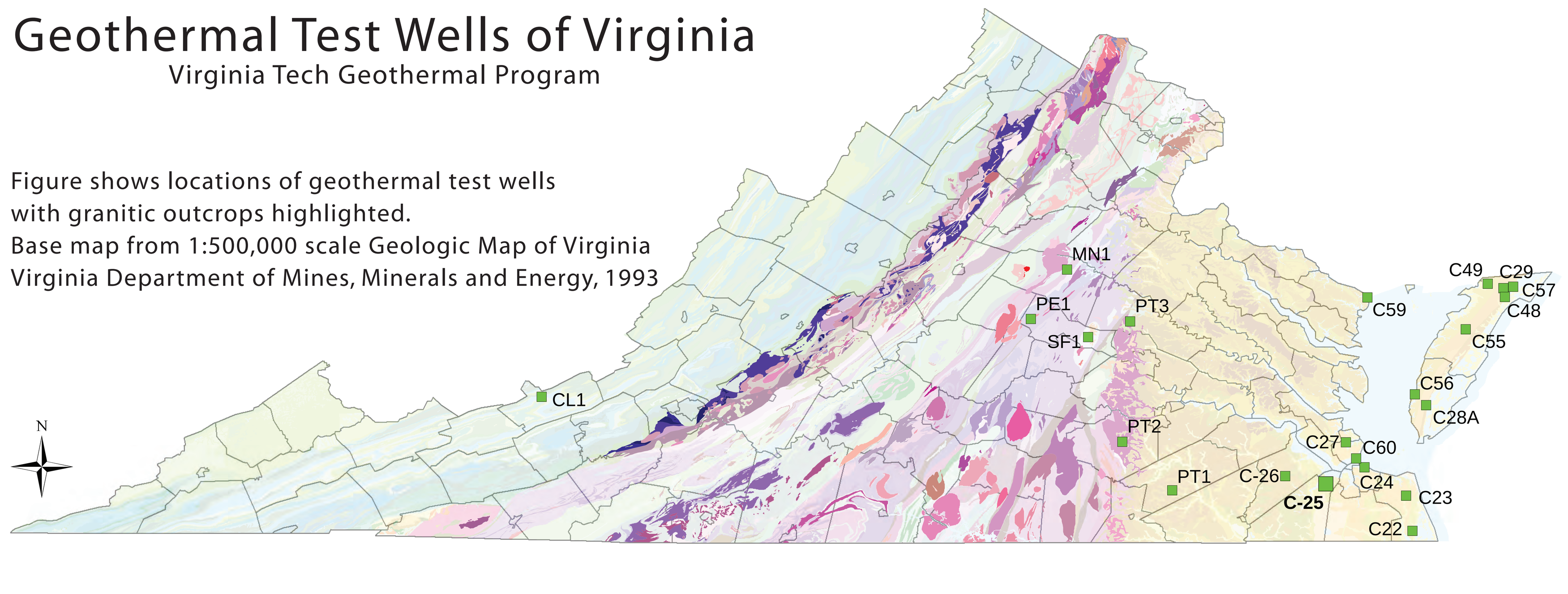
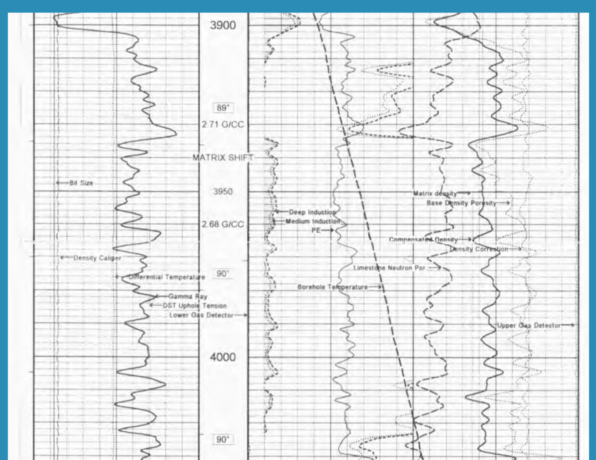
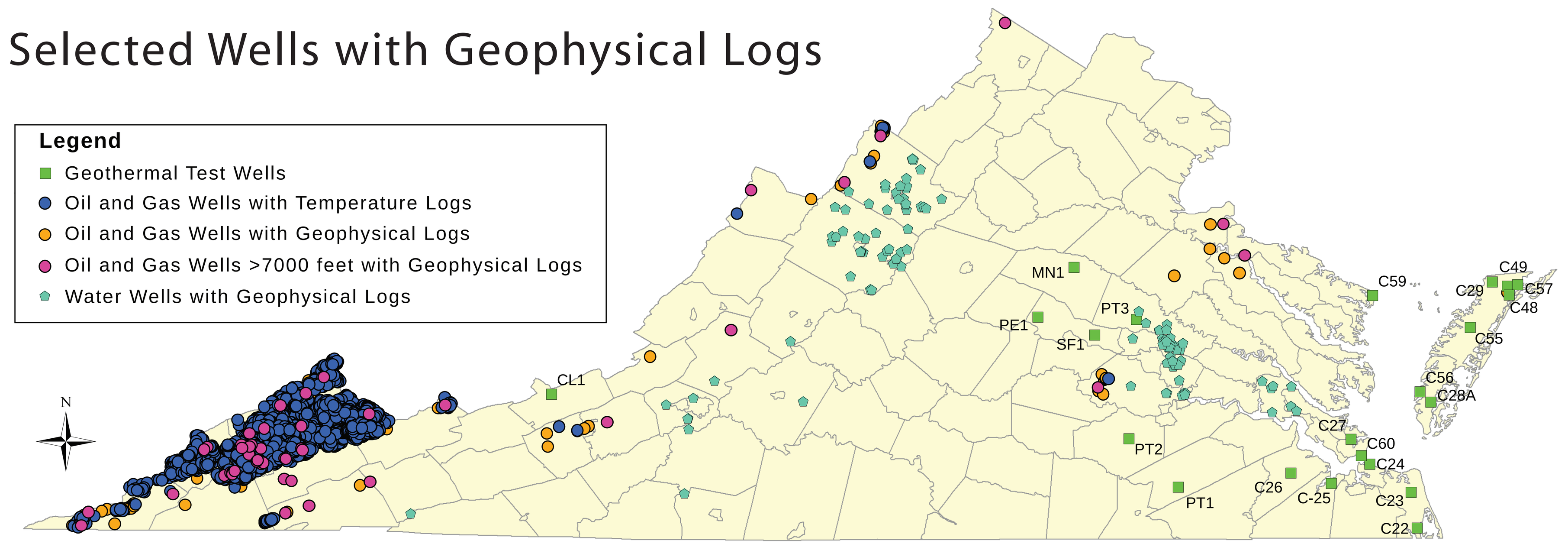


Figure shows locations of geothermal test wells with granitic outcrops highlighted.
Base map from 1:500,000 scale Geologic Map of Virginia
Virginia Department of Mines, Minerals and Energy, 1993



Selected Wells with Geophysical Logs



The Radiogenic Model

Optimum sites for low-temperature (< 300°F) geothermal resources in the tectonically stable eastern United States will probably be associated with crustal igneous rocks that contain relatively high concentrations of the heat-producing radioactive isotopes of uranium, thorium, and potassium. Moderate amounts of heat-producing isotopes occur in all crystalline basement rocks, but the principal geothermal targets in the southeastern U.S. are the relatively young (257-330 Ma) syn- and postmetamorphic U- and Th-bearing, heat-producing granitoid bodies that were intruded into the crystalline basement of the now-exposed Piedmont. They also occur in the basement beneath the sediments of the Atlantic Coastal Plain. The sediments, because of their low thermal conductivity, act as a thermal insulator, like a sweater. Granitoids crop out over a large area of the central and southern Appalachian Piedmont and Blue Ridge, and extend eastward in the basement rocks concealed beneath the sediments of the Atlantic Coastal Plain. A conspicuous negative Bouguer gravity anomaly is generally associated with the granitoid. The combination of relatively high heat flow from a heat-producing granitoid concealed beneath sediments of relatively low thermal conductivity was defined by Costain and others (1980) as the radiogenic model.

The model was confirmed at the Portsmouth, VA, drill site C-25, where a -40 mgal Bouguer gravity anomaly near Portsmouth, Virginia was believed to be caused by a granite body beneath the sediments of the Atlantic Coastal Plain. Hole C-25 was drilled into a late Alleghanian, unmetamorphosed, heat-producing granite and produced higher temperatures than in nearby hole C-26, which was drilled into non-granitic, non-heat-producing, metamorphosed country rock into which the granite was intruded. The higher temperatures in C-25 are a direct result of the extra heat produced by the radioactive decay of U, Th, and K (about 80% of the heat comes from U and Th) in the granite beneath C-25. The optimum sites for geothermal resource development are therefore over such granite bodies because higher temperatures are reached at shallower depths. Where the granites are concealed beneath Coastal Plain sediments, or where they do not reach the top of crystalline basement they can be located by geophysical exploration using gravity and magnetics (Costain, et al., 1980).

Thermal Springs of Virginia

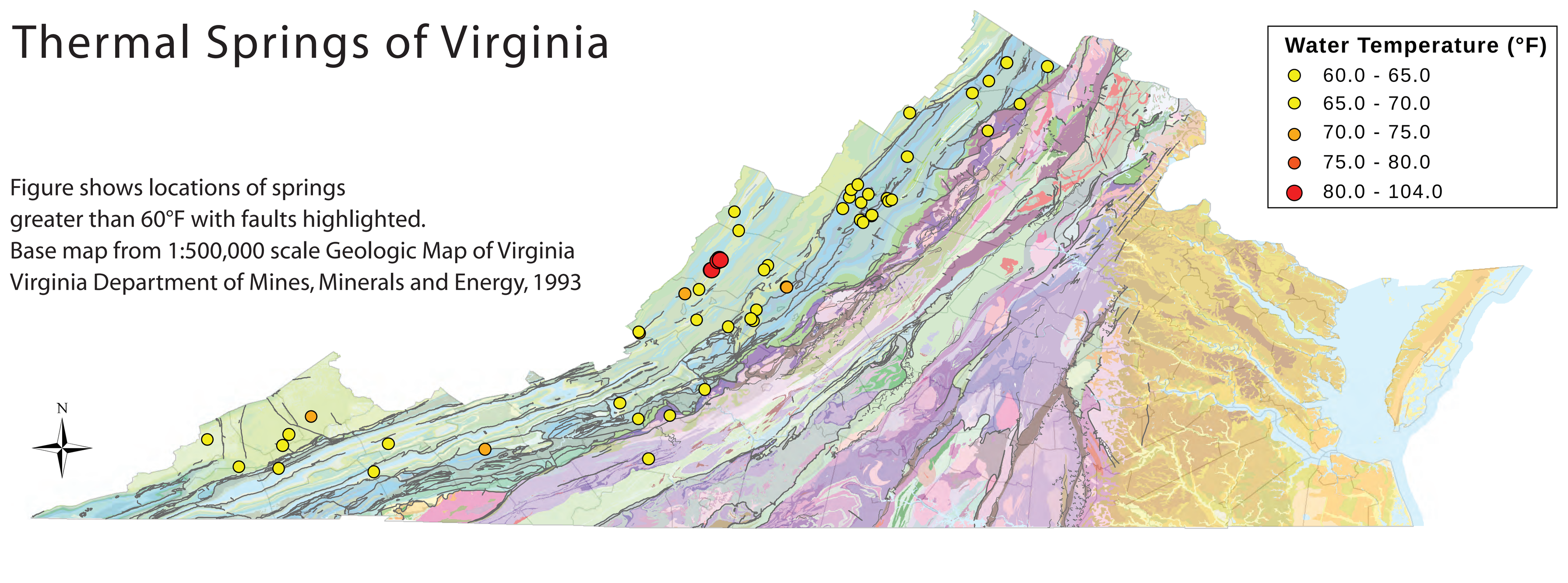


Figure shows locations of springs greater than 60°F with faults highlighted.
Base map from 1:500,000 scale Geologic Map of Virginia
Virginia Department of Mines, Minerals and Energy, 1993

Acknowledgments

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