Virginia Department of Mines, Minerals and Energy
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Virginia Division of Geology and Mineral Resources
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Evolution of Virginia's Geologic Maps

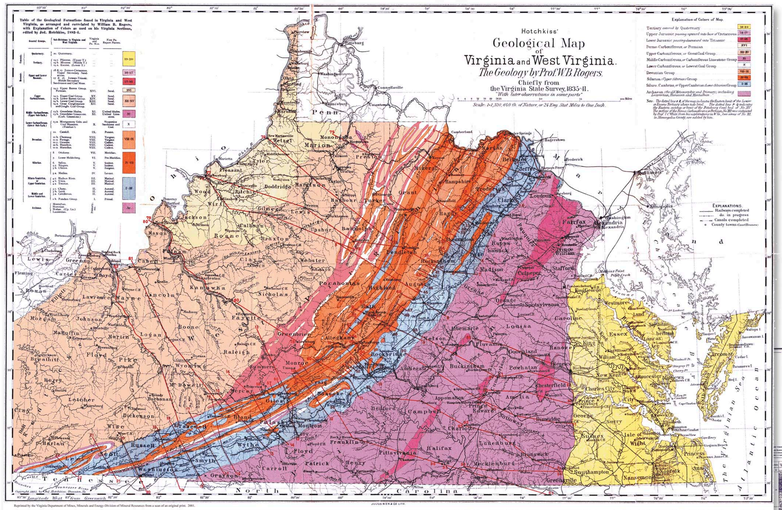
EVOLUTION OF VIRGINIA'S GEOLOGIC MAPS
170 YEARS OF DISCOVERIES

The science of geology has seen dramatic changes over time. The development of new tools, technologies, and theories has spurred rapid advances in the ability of geologists to observe and interpret how the earth has evolved. These advances have also forced periodic rethinking and modification of many of the details and relationships depicted on geologic maps of the earth's surface. The Geologic Map of Virginia, from its earliest version in 1841 to its modern equivalent, reflects those advances in the increasing level of detail in each new version. Virginians have realized increasingly greater benefits from the growing level of sophistication of our state's geologic maps. Benefits include the encouragement of economic development through the wise management of Virginia's energy, mineral, land, and water resources, and enhanced public safety through the identification of geohazards.

The past holds a lesson for the future. The Geologic Map of Virginia, and the many detailed local maps that support its creation, will continue to evolve and improve. Digital versions of the state's geologic maps will make future access to them almost instantaneous. The one unchanging requirement for the creation of any geologic map is the dedicated effort of the geologists who put "boots on the ground" and apply the most current scientific methods and theories to the interpretation and documentation of their field observations. Geologists at Virginia's geological survey, now called the Division of Geology and Mineral Resources within the Department of Mines, Minerals and Energy, continue to lead this effort in Virginia, ensuring that the citizens have the benefit of the most accurate understanding of the state's geology.

Geologic Mapping of W. B. Rogers, 1835-1841

Originally compiled by Rogers for inclusion in J. Hotchkiss' 1876 "Summary of Virginia", 1884



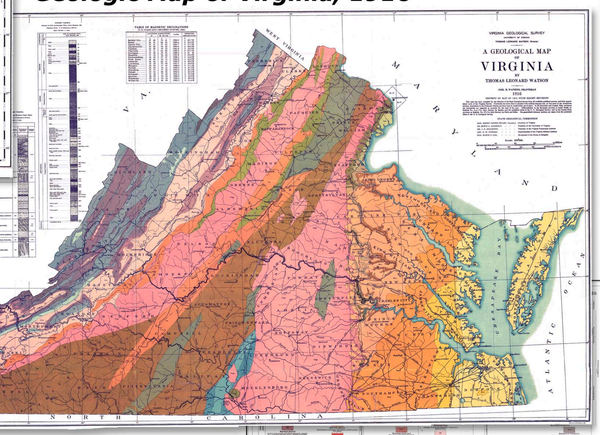
In 1835, William Barton Rogers was asked by the Virginia legislature to undertake a geological survey of Virginia. The field work lasted 6 years and during that time Rogers employed 11 assistants, some for a year, others longer. Rogers made annual reports to the Virginia legislature starting in 1835. Originally planned for seven years, the Legislature repealed the funding after the sixth year, prior to the compilation of the field work into a final report and map.

By the time of Roger's death in 1882, the "Annual Reports" had become hard to find. His wife undertook the job of completing the compilation of his Annual Reports and subsequent papers on Virginia geology, publishing it in 1884. It was accompanied by a small geological map and multiple cross-sections, drafted by Jedediah Hotchkiss, geologist and noted Civil War topographer. The small map was a reproduction of a map that Roger compiled, in 1873, to accompany Hotchkiss' "Summary of Virginia", published in 1876.

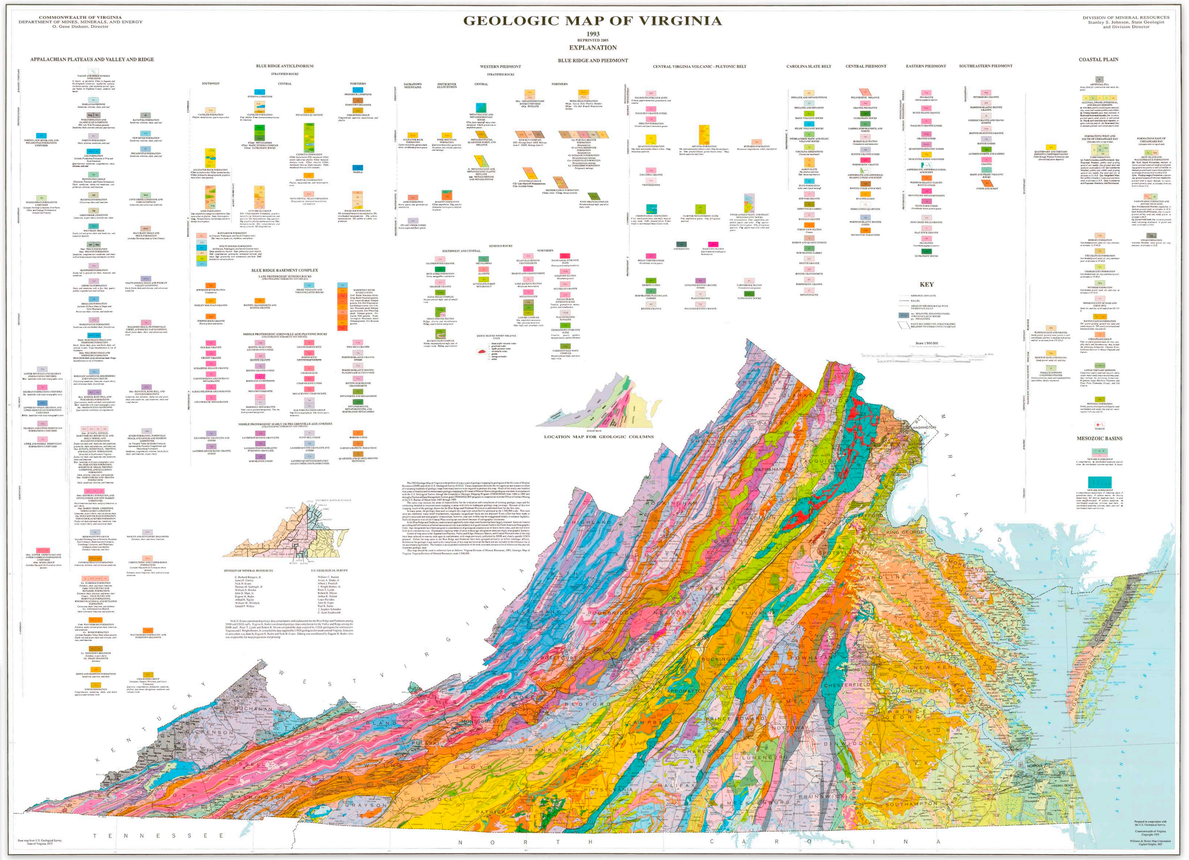
The large, detailed geologic map originally envisioned as the culmination of the survey was never printed due to a lack of funding.

William Barton Rogers was appointed to the chair of Natural Philosophy at the then new University of Virginia in 1835. He also served as State Geologist of Virginia from 1835 to 1848. Rogers resigned his professorship in 1853 and moved to Boston where he was instrumental in founding M.I.T. Rogers was president of M.I.T until 1881.

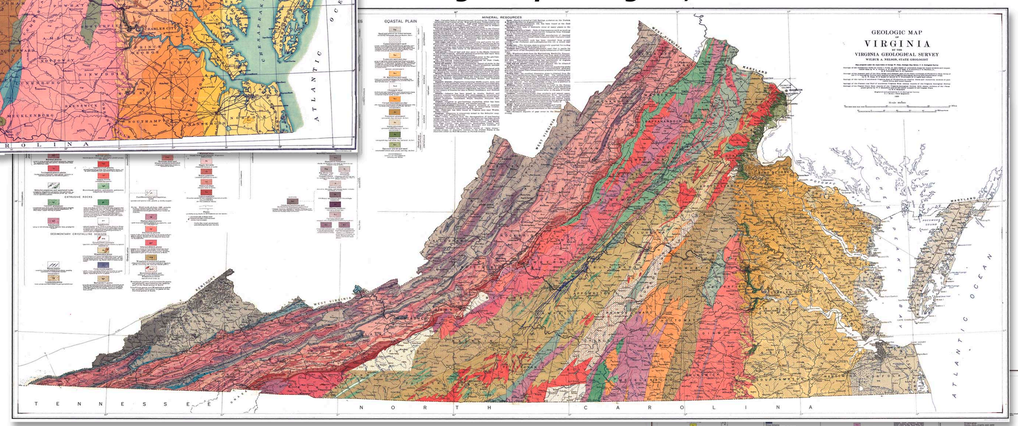
Geologic Map of Virginia, 1916



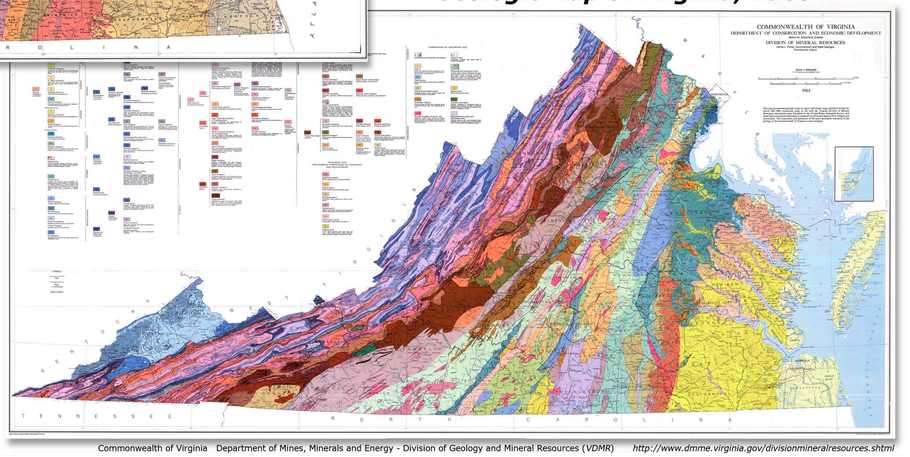
Geologic Map of Virginia, 1993



Geologic Map of Virginia, 1928



Geologic Map of Virginia, 1963



Field transportation

Many technological advances have improved the geologist's ability to make field observations. However, some less obvious changes have been equally significant.

For example, not only have improvements in transportation made it easier and faster to get to and from the mapping areas, the many road cuts necessary for railroads and modern highways expose rocks that would otherwise not be seen.

An outcrop of the Kennedy coal in Wise County uses the geologist's horse as scale. The photograph was taken during the 1913-1914 field season.

An outcrop near Cleveland in Russell County with the geologist's car used as scale. The photograph was taken around 1933.

Highlights in the History of Geology in Virginia

1775 - Geology was first taught as a science by Abraham Werner at a mining academy in Freiburg, Germany.

1779 - William Smith, the "Father of Stratigraphy", produced the first large scale detailed geological map of the area around Bath, England.

1803 – Lewis & Clark expedition set out with instructions to note "...the mineral productions of every kind; but more particularly metals, limestone, pit coal and saltpetre; salines and mineral waters, noting the temperature of the last and such circumstances as may indicate their character; volcanic appearances;..."

1825 - First geologic map of a state in the United States of America published (North Carolina).

1833 - General geological time scale based on fossils and stratigraphic mapping began to be established.

1835 - Virginia's legislature commissioned the first geological survey of the state.

1842 - William B. Rogers and his brother Henry (Director of the New Jersey Geological Survey) presented their theory for the formation of the Appalachian Mountain chain. Based on observations of the folded rock strata that they had made in Virginia and Pennsylvannia, they felt strongly that the rock had been deformed by lateral pressure being applied to essentially horizontal strata.

1850's – First petrographic microscope invented.

1857 - Geosynclinal theory proposed by James Hall as an explanation of the origin of mountains and thick sedimentary units, rejecting the theories of Elie de Beaumont and William and Henry Rogers.

1884 - Publication of W.B. Rogers's work in *A Reprint of Annual Reports and Other Papers on the Geology of the Virginias.*

1894 - D. W. Brunton patented the Brunton compass.

1907 – Radiometric age dating introduced.

1912 - Alfred Wegener formally proposed the hypothesis of "Continental Drift"

1917 – U. S. military began using aerial photography.

1921 - Aerial photography first used to produce a map of Manhattan Island, thereby proving its non-military usefulness (George W. Fairchild).

1935 – Charles Richter invented a logarithmic scale to measure the intensity of earthquakes.

1953 – Maurice Ewing and Bruce Heezen discovered the "Great Global Rift" running along the Mid-Atlantic Ridge.

1959 - First publication of age dates for Virginia igneous rocks.

1960's - Plate tectonic theory developed, replacing the geosynclinal theory.

1966 – Regional geophysical surveys started in Virginia.

1972 – Modern 7.5-minute topographic map coverage of Virginia completed at 1:24,000-scale.

1972 – First Landsat earth-imaging satellite was launched by NASA.

1977 – First gravity and aeromagnetic maps of Virginia published.

1980 - Luis Alvarez and others proposed asteriodal impact theory for the extinction of the dinosaurs at the end of the Cretaceous Period.

1850's

Petrographic microscope

Petrographic microscopes are used to observe minerals in thin (1/1000 of an inch) sections of rock. A petrographic microscope has filters that allow the light to be polarized.

Minerals that look similiar in normal light may look distinctly different in polarized light.

Petrographic microscope circa 1880.

1890's

Brunton compass

A Brunton compass is a compact and very portable combination of a clinometer and a highly accurate transit compass, which can be adjusted for magnetic declination.

It is used by geologists to measure the orientation and dip of rock strata.

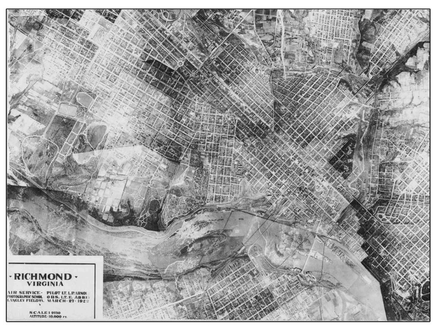
Virginia Geological Survey field geologist using a Brunton Compass circa 1915.

1930's

Aerial photography

Aerial photographs, whether taken from a balloon or a plane or a satellite, greatly facilitate map making. Calculating elevation from pairs of photographs increased the production of topographic maps. Geologists no longer had to produce their own base maps.

George W. Fairchild in 1929 with his latest camera and specially modified airplane. *(Courtesy of aerofiles.com)*



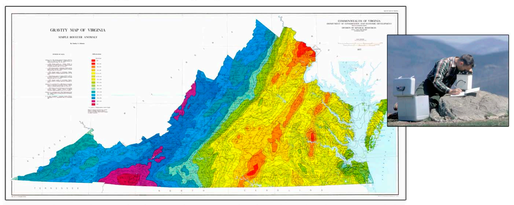
Aerial photograph of Richmond, Virginia, 1922. *(VDGMR archives.)*

1960's

Geophysical surveys

Starting in the 1960's, technologic developments, particularly computational, made it practical for geologists to measure earth's properties in new ways. Geophysical surveys proved very useful in locating valuable mineral resources.

The earliest geophysical surveys measured gravity and magnetic anomalies. Gravity surveys measure the difference between the predicted gravity and the actual measured gravity at a particular location. The differences or anomalies are caused by contrasts in rock densities. An anomaly may indicate the presence of crystalline rock. Magnetic surveys are similiar and indicate the locations of rocks containing relatively more iron and titanium. Other types of surveys include radiometric surveys, and ground penetrating radar surveys, and seismological profiles.



Gravity Map of Virginia. This map is the culmination of gravity surveys done during the 1960's. Red areas are gravity highs; purple indicate areas with lower than predicted gravity. Both types of anomalies are important.

1980's

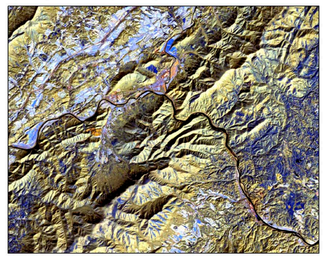
Satellite data

Geologists use satellites to locate mineral deposits, and monitor glaciation, desertification, and shoreline erosion, and map faults and geologic hazards. Sensors on satellites enable scientists to collect data over a large area at one time and to gather information in areas that are difficult to access. The predictability of satellite orbits allow scientists to study change over time by enabling them to collect data from the exact same area at repeated intervals.

Data from a LANDSAT TM satellite sensor were used to create the image to the right which shows the James River flowing from the Valley and Ridge physiographic province of Virginia through the Blue Ridge Mountains near Glasgow, Virginia, and into the Piedmont.

The image was created using electromagnetic radiation (infra-red) that the human eye cannot detect.

Landsat TM bands 7, 5, and 4 are displayed as red, green, and blue respectively. Areas of active plant growth are blue. Sunlight is from the lower right.



Campbell, Elizabeth V. M., 2008, Evolution of Virginia's Geologic Maps: Virginia Division of Geology and Mineral Resources, Open-file Report 08-03.