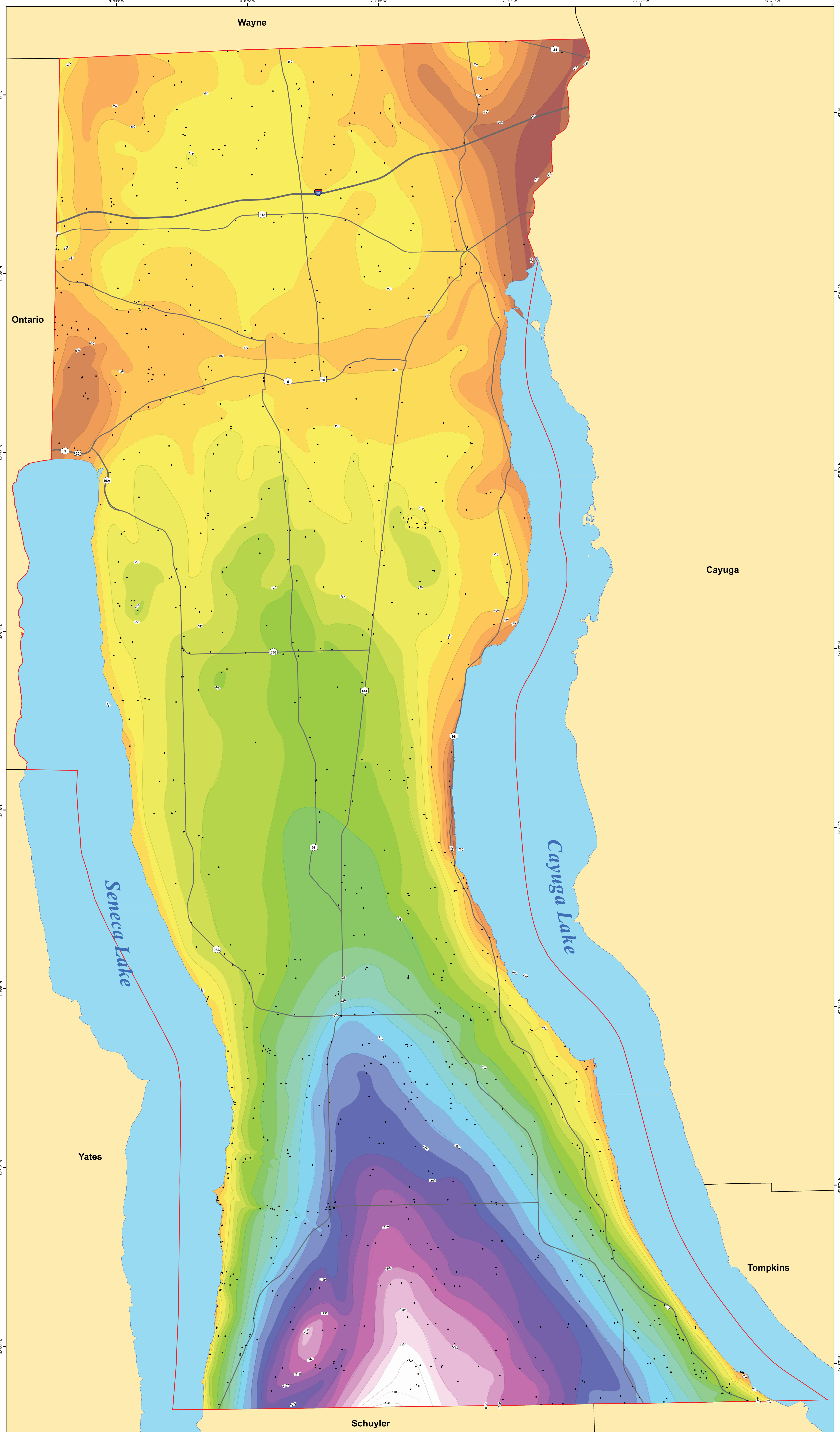
New York State Museum
Mark Schaming, Director

New York State Geological Survey
Dr. Andrew Kozlowski, Director

BEDROCK TOPOGRAPHY OF SENECA COUNTY, NEW YORK

Karl J. Backhaus

2023



Digital Data and Cartography by K. Backhaus, 2021-2023.

Universal Transverse Mercator, Zone 18 N North American Datum of 1983

Geographic and hydrograpghy data obtained from the NYSGIS Clearinghouse (https://gis.ny.gov/)

Shaded relief from Seneca Watershed 2m and Central Finger Lakes 1-meter Lidar data sets by NYSGPO & FEMA (http://gis.ny.gov/elevation/index.cfm)

SCALE 1:62,500

Kilometers: 0, 1.5, 3, 6, 9, 12
Meters: 0, 6,250, 12,500
Miles: 0, 0.5, 1, 2, 3, 4
Feet: 0, 4,000, 8,000, 16,000, 24,000, 32,000

Digital data and cartography, K. Backhaus, 2021-23.

Introduction

Beginning in 2019, with guidance and funding (award G20AC00401) provided by the United States Geological Survey - Great Lakes Geological Mapping Coalition, the New York State Museum-Geological Survey began a statewide effort to complete mapping the elevation of bedrock topography. Seneca County is located in the glaciated terrain that spans from the Erie-Ontario Lowlands to the Allegheny Plateau physiographic provinces and nestled between Cayuga and Seneca Lake in the northern Finger Lakes. Field mapping completed in the early to mid-2010's in the Lyons, Savannah, Cayuga, Montezuma, Union Springs, Sheldrake, Ludlowville and Trumansburg 7.5-Minute quadrangles (Bird and Kozlowski, 2014; Bird, Kozlowski and Backhaus, 2018; Kozlowski, Bird and Backhaus, 2009; Kozlowski, Backhaus and Bird, 2021; Kozlowski and others, 2016; Kozlowski and others, 2016; Backhaus, Kozlowski and Leone, 2018; Backhaus and Kozlowski, 2021). proved that bedrock outcrops are obscured by thick deposits of glacial sediment. Combining the field mapped data with a compilation of subsurface well data, we developed a workflow to best understand the subsurface framework to delineate the Paleozoic bedrock surface from overlying Pleistocene sediment. The resulting map of bedrock topography proved consequential to create another derivative map of the county's drift (glacial sediment) thickness. Detailed mapping of Seneca County's bedrock topography may be useful for a host of land management and geologic applications such as geothermal energy, water resources extraction and protection, and aggregate resources. The data from this map may be particularly informative in the discovery and description of freshwater aquifers, as well as providing boundary data that permits more rigorous modeling of contaminant movement through groundwater. Finally, these products provide important context for understanding the natural history of the county, such as understanding the geomorphology of the bedrock surface and location of buried stream valleys. Some of the bedrock topography may predate or have survived severe erosion that resulted by repeated Pleistocene glacial advances in the last 2.68 million years.

Methods

To create the map of the county, a total of 999 bedrock control points were compiled to delineate the bedrock topographic surface. These points consist of 701 water wells, 235 water resource wells, from Mozola (1951), 21 waterfall locations, 20 engineering boreholes, 20 known bedrock outcrops and two exploratory boreholes. Using the coordinates of these compiled points, the surface elevation was extracted from a compilation of three separate digital elevation models (DEM) files which were resampled to a matching 1-meter lidar DEM cell size. Once the elevation was gathered, the depth to bedrock was subtracted from the surface elevation to determine the bedrock elevation. The resulting elevation is the true (best estimated) bedrock surface elevation. These data were entered ESRI's ArcMap 10.8 program and using the "Contours" tool, 50ft contours were generated (see inset map to the bottom right). Using the bedrock surface elevation from each point and knowing the surface elevation in the county, the contours were adjusted manually through a multi-review process to fix any errors created by the tool. The contours, after being adjusted, were then converted into a 1-meter raster using the "Topo to Raster" tool. Throughout this process, the Cayuga and Seneca Lake basins were excluded as depth to bedrock is often unknown, or poorly constrained within the lakes themselves.

Discussion

Upon completion of the Bedrock Topography of Seneca County map, the bedrock topography was found to range from 100 to over 1,620 feet in elevation above mean sea level. The lowest elevations were found in the northeast corner of the county, near the outlet of Cayuga Lake along the Seneca River in the Montezuma National Wildlife Refuge. The lower elevations in the northeast corner were determined by the New York State Geological Survey's exploratory boreholes AMZ-11-1 along New York State 31 and BH1604 in the Unit 17 of the wildlife refuge adjacent to the Seneca River. The highest bedrock elevation is found along the southern border of the county near the Schuyler and Tompkins County Line's.

The completed map reveals a broad bedrock ridge rising in elevation from north to south. The overall topography is streamlined south of the Seneca River towards the south topping off at the triangular peak at the south-central border of the county. This triangular shape observed in multiple tiers from white to lime green color represent the various layers of bedrock starting from the Beers Hill Shale of the West Falls Group on a bedrock structure called the Hector Backbone. Towards the north, the lithology changes to the Middlesex Shale, then then Ithaca Formation and progressively older units in the Camillus and Syracuse Formations of the Salina Group. The least-resistant layers of shales weathered quickly compared to other like the Genundewa Limestone creating a resistant apron above 660ft in elevation (Rickard and Fisher, 1970). Two deep bedrock valleys are present in the northern portion of the county on the east and western borders in the formations within the Salina Group. These are associated with buried bedrock valleys at the north ends of both Finger Lakes. This valley is also indicative of the paleoflow direction of the ice sheet through this region. The valleys formed by erosion perpendicular to the hydraulic gradient of the ice sheet itself. These deeper valleys continue into Cayuga and Wayne Counties with the western valley continuing north of Lake Ontario (Backhaus and others, 2019; Backhaus, 2023). Another bedrock valley is associated with the modern flow pattern of the Seneca River, likely representing an older stream or over-deepening by meltwater streams during glacial retreat.

Error Analysis

Common errors were caused by the deficiency of bedrock control points in many areas of the county, which made correlating the buried bedrock surface difficult. The distribution of wells within the county is random and is not standardized. The bedrock depth indicated on the older publications were sorted and either accepted or rejected based on their relative depths of surrounding, newer well data.

Conclusions

The difference in elevation atop and below the Niagara Escarpment suggest multiple episodes of differential erosion during the Pleistocene Epoch overtop the undulating surface of the various Paleozoic bedrock lithologies in this county. Shales and limestones were more susceptible to erosion compared to the more-resistant sandstone layers This map shows the continuation of a previously identified buried bedrock valley that likely connected Lake Ontario to Seneca Lake prior to being infilled by sediments during previous glacial periods. Similarly, this map also shows the western boundary of a buried bedrock valley that was previously seen in Wayne and Cayuga Counties within the Montezuma National Wildlife Refuge. Overall, the bedrock topogra phy of Seneca County shows a triangular, step-like increase in bedrock topography towards the south only truncated by a bedrock valley like the trend of the modern Seneca River from west to east across the county. This overall topography is likely controlled by the weathering characteristics of the bedrock over multiple glacial episodes. The work completed by the New York State Museum-Geological Survey has created the first high-resolution Bedrock Topography Map for Seneca County. Continuedresearch and work on the subsurface geology in Seneca County will provide additional and requisite data to enhance and revise this map. Our office is also open to suggestions and tips on how to improve this and future map products. Any information or data that is provided will be acknowledged and added as a contributor on a revised publication.

Explanation

- Reference Point
- 50ft Contour
- 100ft Contour
- Highway
- Seneca County Line
- Adjacent County
- Water Body

Bedrock Topography

Feet-amsl

- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- 300 - 350
- 350 - 400
- 400 - 450
- 450 - 500
- 500 - 550
- 550 - 600
- 600 - 650
- 650 - 700
- 700 - 750
- 750 - 800
- 800 - 850
- 850 - 900
- 900 - 950
- 950 - 1,000
- 1,000 - 1,050
- 1,050 - 1,100
- 1,100 - 1,150
- 1,150 - 1,200
- 1,200 - 1,250
- 1,250 - 1,300
- 1,300 - 1,350
- 1,350 - 1,400
- 1,400 - 1,450
- 1,450 - 1,500

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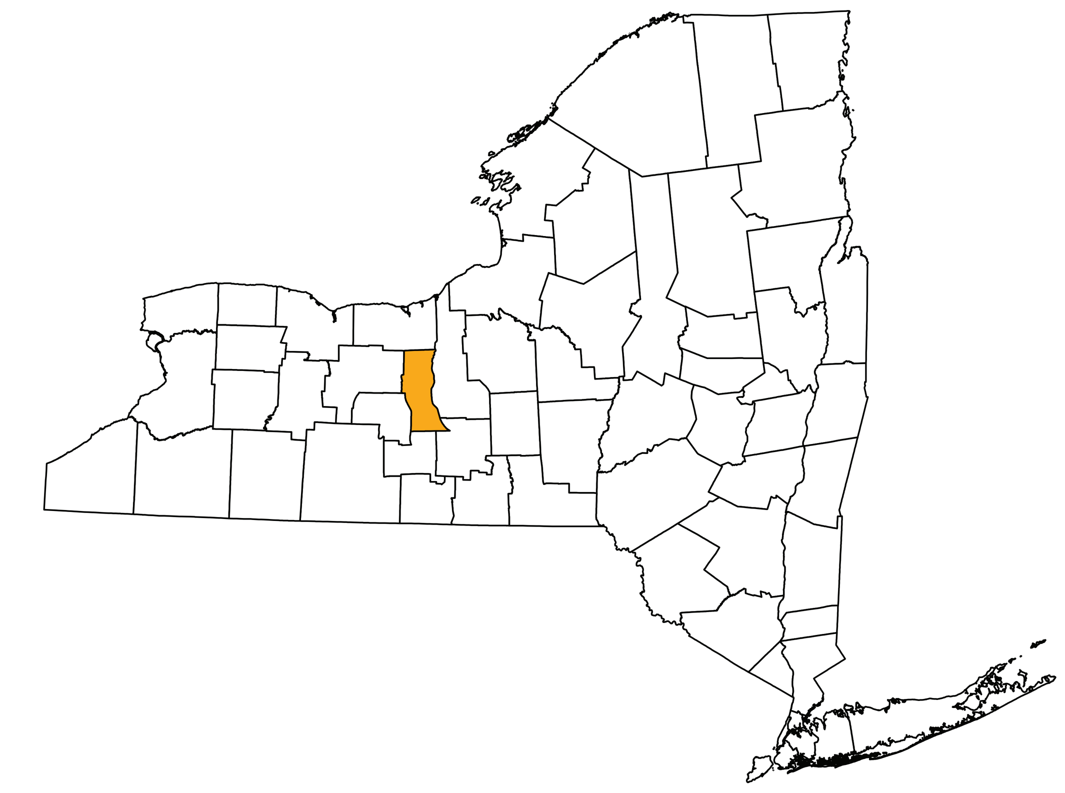

New York State Museum Map & Chart No. 168

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