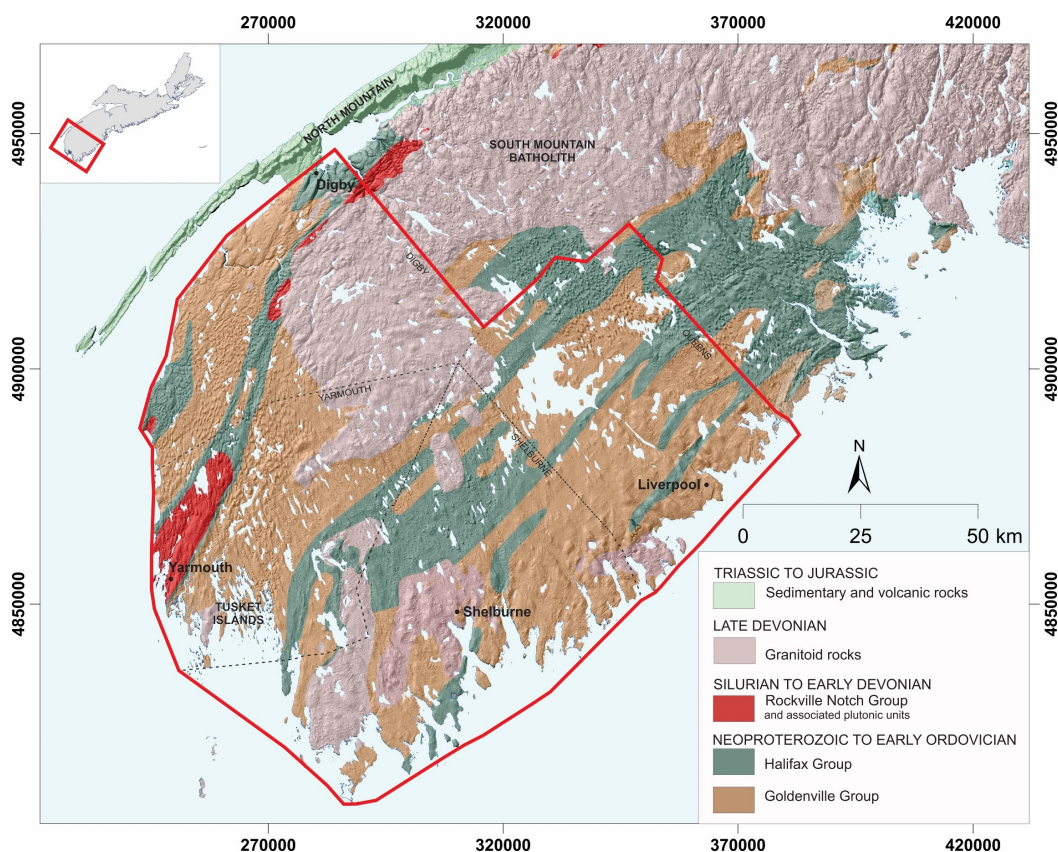


Data Generated by Sediment Thickness and Bedrock Topography Model of Southwest Nova Scotia

D.M. Brushett, G.W. Kennedy, and C.C. MacMullen

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Cover Illustration

Simplified regional geology of southern Nova Scotia (White et al., 2012) overlain on a lidar hillshade image (azimuth of 315°). The study area extents are outlined in red.

Note

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Data Generated by Sediment Thickness and Bedrock Topography Model of Southwest Nova Scotia

D.M. Brushett, G.W. Kennedy¹, and C.C. MacMullen²

Introduction

This report outlines the methods and data sources used to generate regional-scale bedrock topography and sediment thickness maps for southern Nova Scotia, including parts of Digby, Yarmouth, Shelburne, and Queens counties (Fig. 1; Brushett et al., 2023). These maps advance our understanding of the bedrock topography of the region and the distribution and thickness of the surficial sediments. They may be used to inform mineral, groundwater, and aggregate exploration, as well as geotechnical investigations, aquifer vulnerability, and surficial geological studies. They will also be used to support ongoing surficial geological mapping by the Department of Natural Resources and Renewables. Model generation was based on data from water-well, drillhole, and test-hole records, along with outcrop points recorded from bedrock mapping. It is important to note that these types of regional-scale interpretations may not be suitable for use in local-scale investigations, where a more detailed assessment may be required.

The study area is part of the Atlantic Uplands (Bostok, 1970) and is characterized by a gently rolling topography with granite uplands (reaching a maximum elevation of 280 m in the South Mountain Batholith), till plains, drumlin fields, and extensive wetlands. The bedrock of southern Nova Scotia comprises the Cambrian–Ordovician metasedimentary rocks of the Halifax and Goldenville groups of the Meguma terrane and, in the western side of the study area, the unconformably overlying Silurian and Early Devonian volcanic and sedimentary rocks of the Rockville Notch Group (Fig. 1). Widespread intrusion of peraluminous granites, including the South Mountain Batholith, occurred during the late Devonian (White, 2010; White and Barr, 2017). These rocks have been eroded since the Jurassic to form a paleosurface that dips gently southeastward. The present surface morphology and drainage patterns reflect multiple glaciations during the Pleistocene. These glaciations resulted in extensive glacial sediment cover that mostly conceals preglacial relief over a large extent of the study area. Drumlinized terrain, which is common throughout the study area, varies in orientation from southwestward to southeastward and is associated with multiple ice-flow phases (Stea et al., 1992). Wetlands are also common throughout the study area, particularly in the southeastern part of the study area where bogs, fens, and peatlands occur over terrain with typically little relief. The Tusket Islands region is characterized by a submerged coastline with fjords (drowned valleys), tidal rivers, tidal inlets, and extensive salt marshes. Sea level has been rising along the Atlantic coast for thousands of years since a post-glacial lowstand (Shaw et al., 2002); the effects of this sea-level rise are particularly pronounced in this region. Tidal gauge data in the Yarmouth area dating back to the early 1900s indicate that sea level has been rising steadily a rate of ~32 cm/century (Utting, 2011).

Data Sources and Methods

The bedrock topography of the study area was generated using raster interpolation tools (Natural Neighbour) in the Spatial Analyst extension of ArcGIS 10.8.1. Depth to bedrock control-point data for 9890 records were derived from four sources: the *Nova Scotia Well Logs Database* ($n = 2729$; Nova Scotia Environment, 2020), the *Nova Scotia Test Holes Database* ($n = 39$; Nova Scotia Department of Natural Resources and Renewables, 2021), the *Nova Scotia Drillholes Database* ($n = 1684$; O'Neill and Poole, 2016), and bedrock outcrop points from bedrock mapping ($n = 5438$, White et al., 2012). Bedrock elevations are expressed as metres above sea level (m asl).

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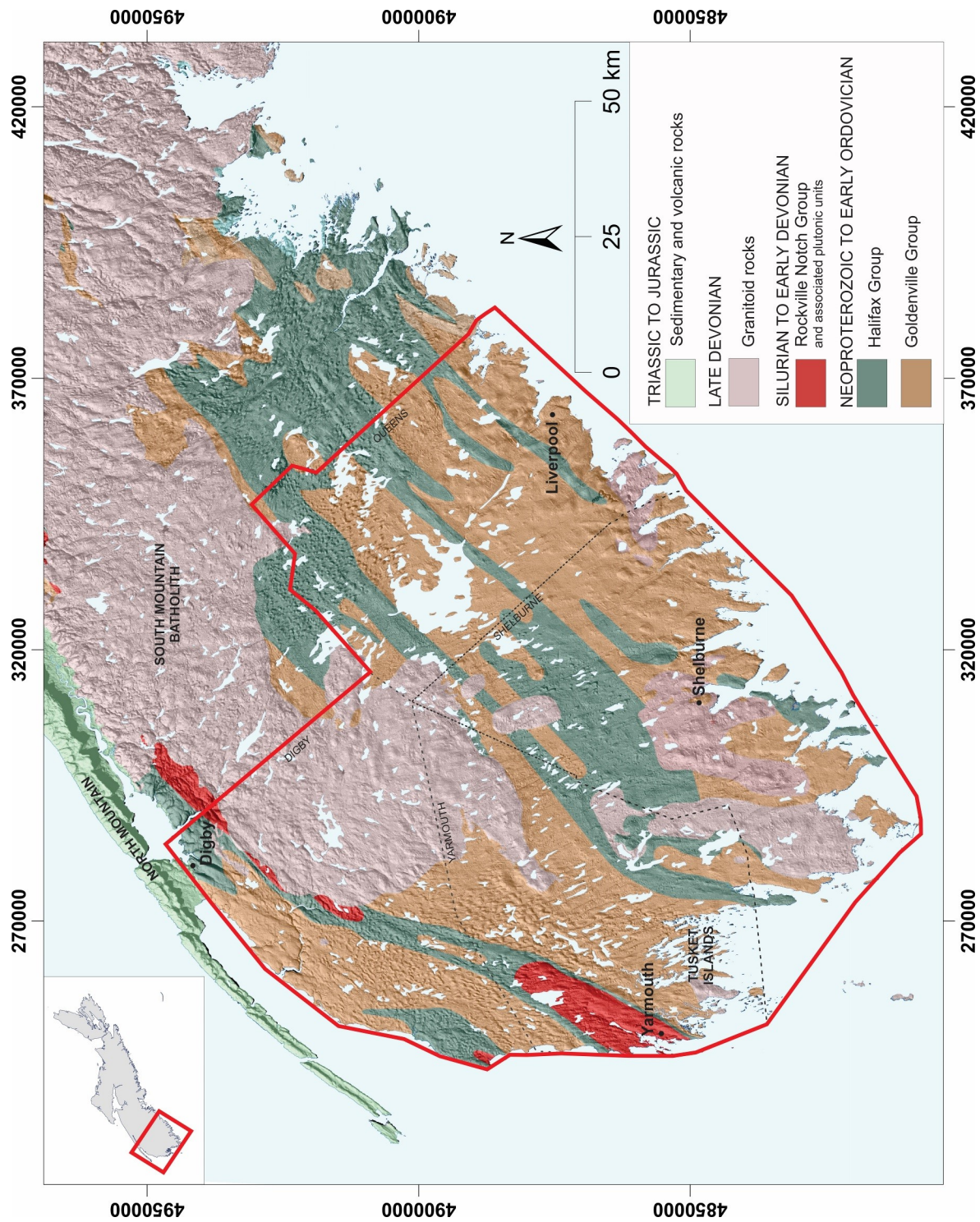


Figure 1. Simplified regional geology of southern Nova Scotia (White et al., 2012) overlain on a lidar hillshade image (azimuth of 315°). The study area extents are outlined in red.

The 9890 records from the data sources cited above were selected because the included geospatial information was considered accurate. Records in the *Nova Scotia Well Logs Database* (Nova Scotia Environment, 2020) that predate 2004 only include property identification information, such as civic or lot numbers. Geospatial coordinates for these locations were obtained from the *Civic Addressing* online database (GeoNOVA, 2020a). Only those water-well records with accuracy within 500 m were included as control-points for the spatial analysis.

For drillhole database records (O'Neill and Poole, 2016), depth to bedrock was calculated using overburden depth and dip measurements. Those records with incomplete data on location, depth, or dip were excluded.

The outcrop points from the mapping data of White et al. (2012) that were used in the present study did not include those identified as float and those labelled as 'no plot' for cartographic thinning purposes.

The initial bedrock topography surface was inspected to identify anomalous depressions and peaks in the bedrock topography. Erroneous data were identified and removed from the dataset before a refined bedrock topography surface was generated. Data points are unevenly distributed throughout the study area, which makes the bedrock surface difficult to interpolate where data are sparse.

The sediment thickness of southern Nova Scotia was calculated as the difference between the interpolated bedrock topography surface and the 5 m lidar surface elevation data (GeoNOVA, 2020b). The raster toolset (minus function) in ArcGIS Spatial Analyst was used for this calculation. Some negative values were identified, typically where there are sudden depressions in the DEM or ground surface. This may happen in areas where a linear surface is interpolated across a steep escarpment or surface depressions, such as a river valley. In the eastern part of the study area, negative values occur in thin drift areas where rivers cut through the drift deposits. Negative values were reclassified as thin drift areas (e.g. 1 m).

Summary

The bedrock topography model depicts a surface that slopes gently to the southeast. The highest elevations, up to 203 m asl, are over the South Mountain Batholith. The sediment thickness model shows the variability in thickness of unconsolidated sediments between the bedrock surface and the present-day land surface. The maximum thickness is 76 m over South Mountain but is typically less than 5 m over the entire study area. This model effectively illustrates regional glacial ice-flow and sediment depositional and erosional histories. Widespread areas of drumlinized terrain are identified on the map (Brushett et al., 2023); drumlin ridges exceed 40 m in thickness and exhibit multiple flow directions. Glaciofluvial and glaciolacustrine deposits commonly occur in topographic lows, which are now occupied by modern rivers and wetlands.

The sediment thickness map (Brushett et al., 2023) and the data of the present Digital Product are preliminary. They provide a foundation for additional classification and field verification, and they should be updated as new stratigraphic information becomes available. This is particularly important for areas in the eastern part of the study area where data control-points are sparse.

Acknowledgments

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