# Fossilized Brachiopods within the Onondaga Limestone

*Examining the spatial distribution of the Brachiopod order Orthida within the Onondaga Limestone Formation*

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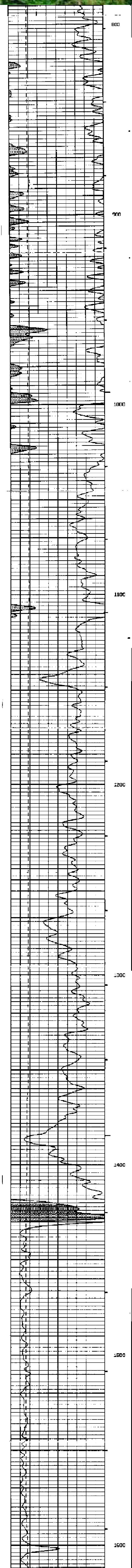


## Introduction

The study of geology has numerous applications. This includes the study of past life on Planet Earth. Extinct organisms trapped and preserved in the fossil record offer a glimpse of prehistoric conditions on Earth, as well as the changes Earth has experienced through geologic time. One area of interest would be the Onondaga Limestone Formation.

The Onondaga Limestone is a geologic formation located in Central New York state. Positioned below the Marcellus Shale (known for its rich natural gas deposits), this Middle-Devonian age rock unit contains an abundance of fossils. One of the most abundant fossil types in this unit is the Brachiopod Order Orthida. This order has many different species that are alive today, and a few that also thrived during the Devonian. The presence of these organisms indicates the depositional environment in which they came to rest. By locating some of the collection points of these fossils, we can answer the question, "What is the spatial distribution of Brachiopoda Orthida in the Onondaga Limestone Formation?" Answering this question will assist with understanding the geological and geographic history of Central New York, as well as how the tectonic changes over geologic time.

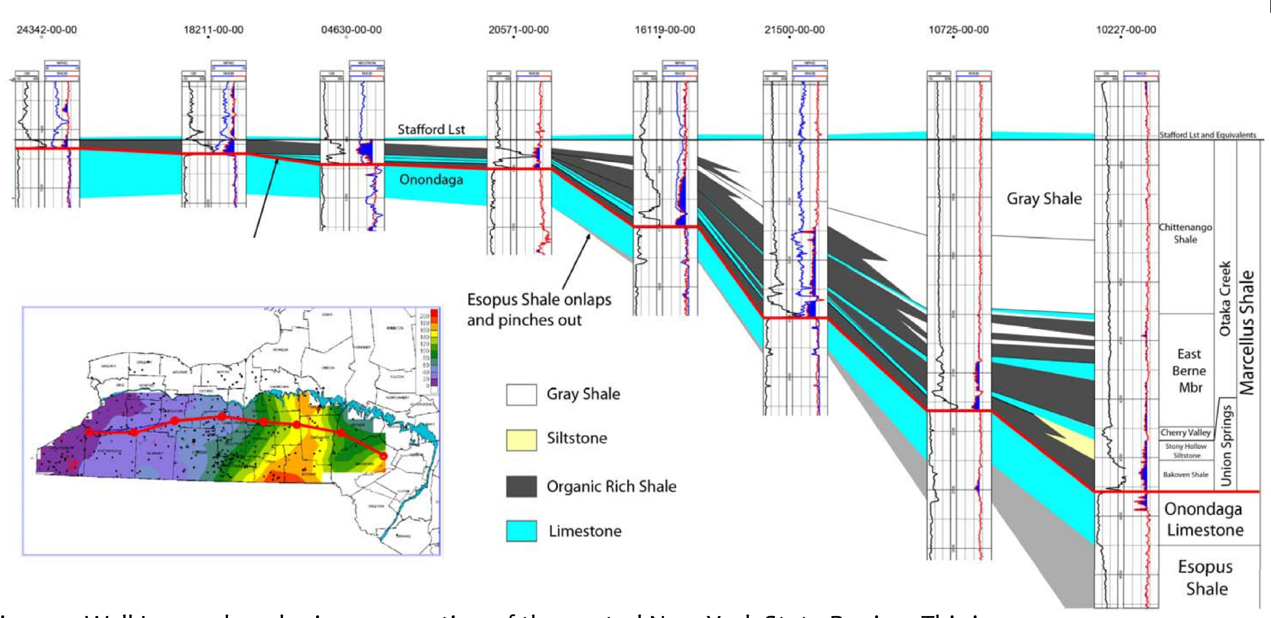



Figure 1: Well Log and geologic cross-section of the central New York State Region. This image was used as a quality assurance tool to ensure that depths calculated were within a reasonable accuracy

## Objectives

In order to answer this spatially based question, spatial data must be acquired. Fossil collection points would be beneficial. These points were locations were individuals have collected fossils and have uploaded specific information about that fossil. In our case, only fossils that were Middle Devonian in age and were members of the Orthida order. Because the Onondaga lies deep underground, there are no existing surficial geology shapefiles of the formation. This must be derived through well logs, provided by the New York State Museum. The depth to the formation will be determined by examining the API values. Limestone gives off lower amounts of gamma radiation compared to other rocks. The top and bottom of the formation is easy to distinguish because the Onondaga sits atop the Esopus Shale and is capped by the Marcellus Shale. Due to the high amounts of hydrocarbons, shale has the largest API values in rock (See Left Banner). The boundary between the two types of geologic units should be relatively easy to distinguish. A number of well log points will be used to create an isoline of the geologic unit. A well log cross section will be used as a reference for quality assurance of the derived subsurface formation (Figure 1). A Digital Elevation Model will be collected as well. Because the Onondaga covers a large distance, multiple DEM's should be collected and added into a mosaic dataset. The DEM dataset will be used to find the actual elevation of each of the well logs. Using the field calculator, the depth to the Onondaga can be calculated for each well log point.

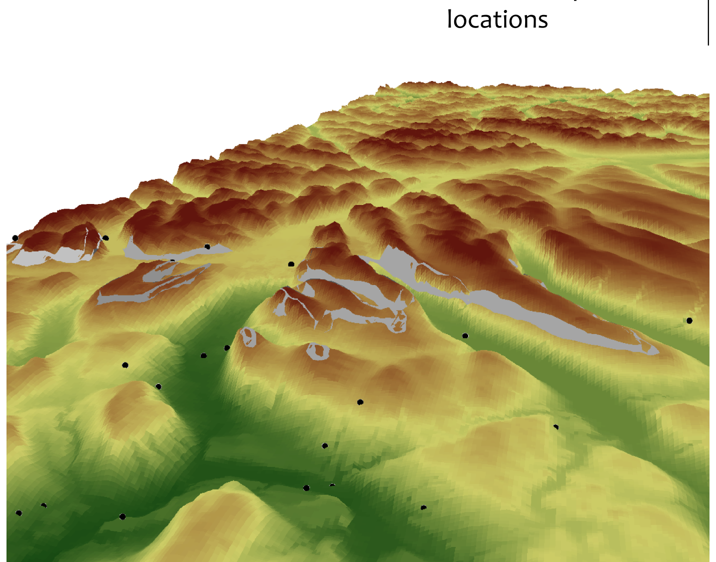
## Methods and Data

Fossil collection data required the use of the Paleobiology Database Map Navigator. Using the filters "Middle Devonian" nad "Orthida", point data for the collection of multiple species of Orthida Brachiopod were projected in the data viewer. The final fossil collection points were downloaded from the Paleobiology Database. These points were then projected onto the NAD 83 State Plane New York Central Spatial Reference System. Several National Elevation Datasets were acquired through the USGS National Map Viewer. These DEM's were referenced to the same spatial reference system and then added to a mosaic dataset within the geodatabase. In order to determine the difference between fossils collected on the surface and fossils collected through rock cores, the New York Surficial Geology shapefile was referenced and added to the map document. From that file, all the Middle Devonian Limestone (the same age and type as our formation of interest) was exported as its own layer. To display the surface outcrops, the DEM and the Middle Devonian Limestone layers were added to Arcscene. By exaggerating the vertical layers and draping the Middle Devonian Limestone layers over the Dem, some outcrops were visualized (Figure 3). Displaying the subsurface geology of the formation required the use of multiple geophysical well logs. Using the knowledge that there will be a drastic difference in gamma radiation between hydrocarbon shale and our limestone formation, the depth to the Onondaga for each well log was calculated into an excel sheet.

## Methods and Data Continued

Using this excel spread sheet, a vector point feature class was created. By using the Multi-values to Points tool, the elevation data connected to the DEM mosaic dataset was added as a new field for each of the well log points. Because this was the elevation for the top of the well casing, the actual elevation to the Onondaga had to be calculated through the Field Calculator. The depth to the formation (found from original well log) was subtracted from the elevation field. This provided the final actual elevation at mean sea level.

Figure 3: Arcscene display of surface outcrop locations



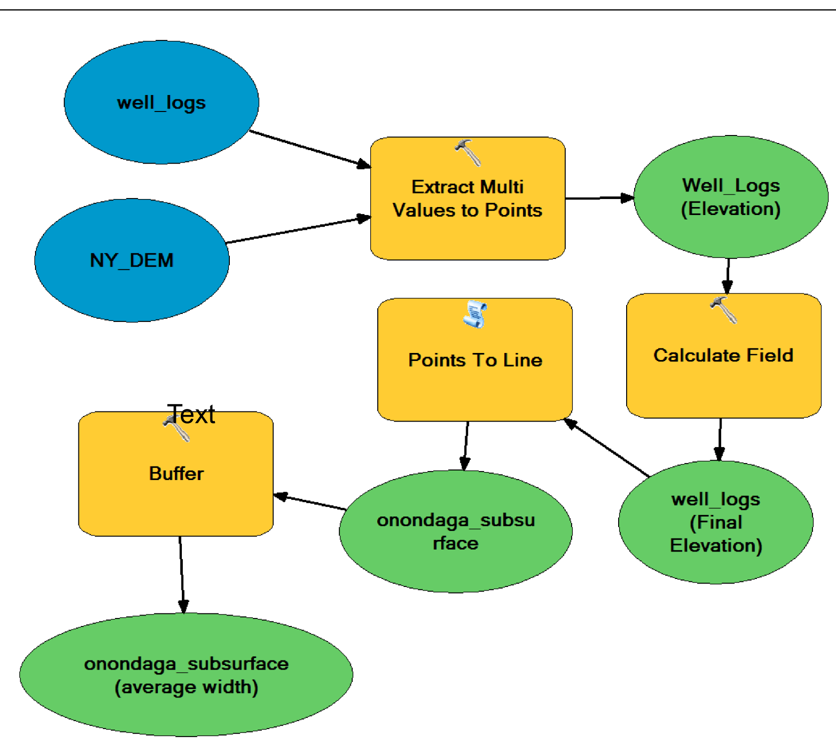



Figure 1: Cartographic Model used to derive subsurface model

Figure 4: Example well log used in deriving formation depth. The depth in this particular log is 1420 ft.

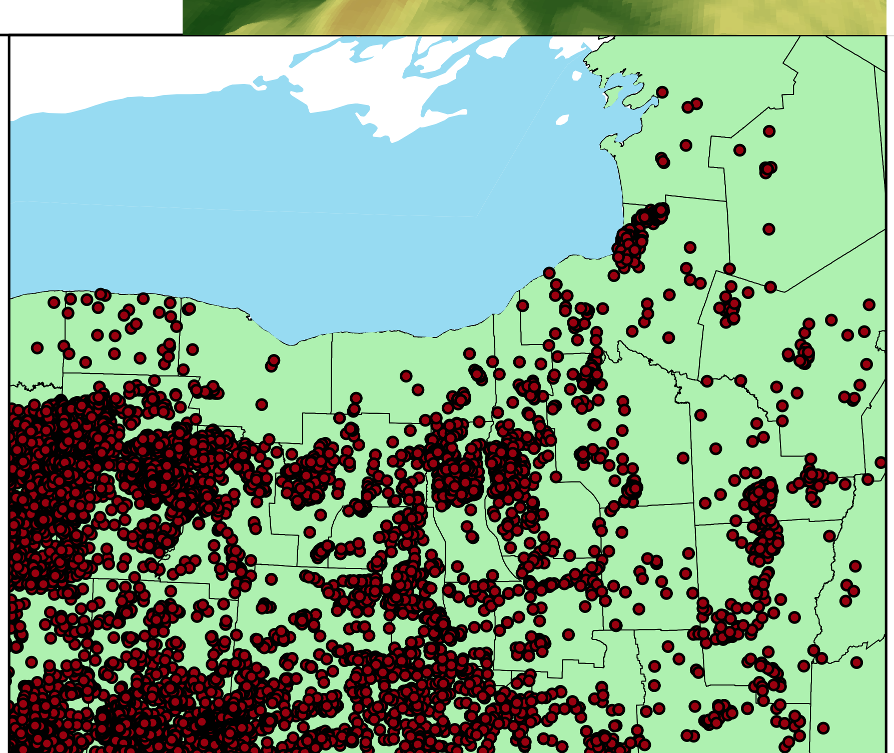
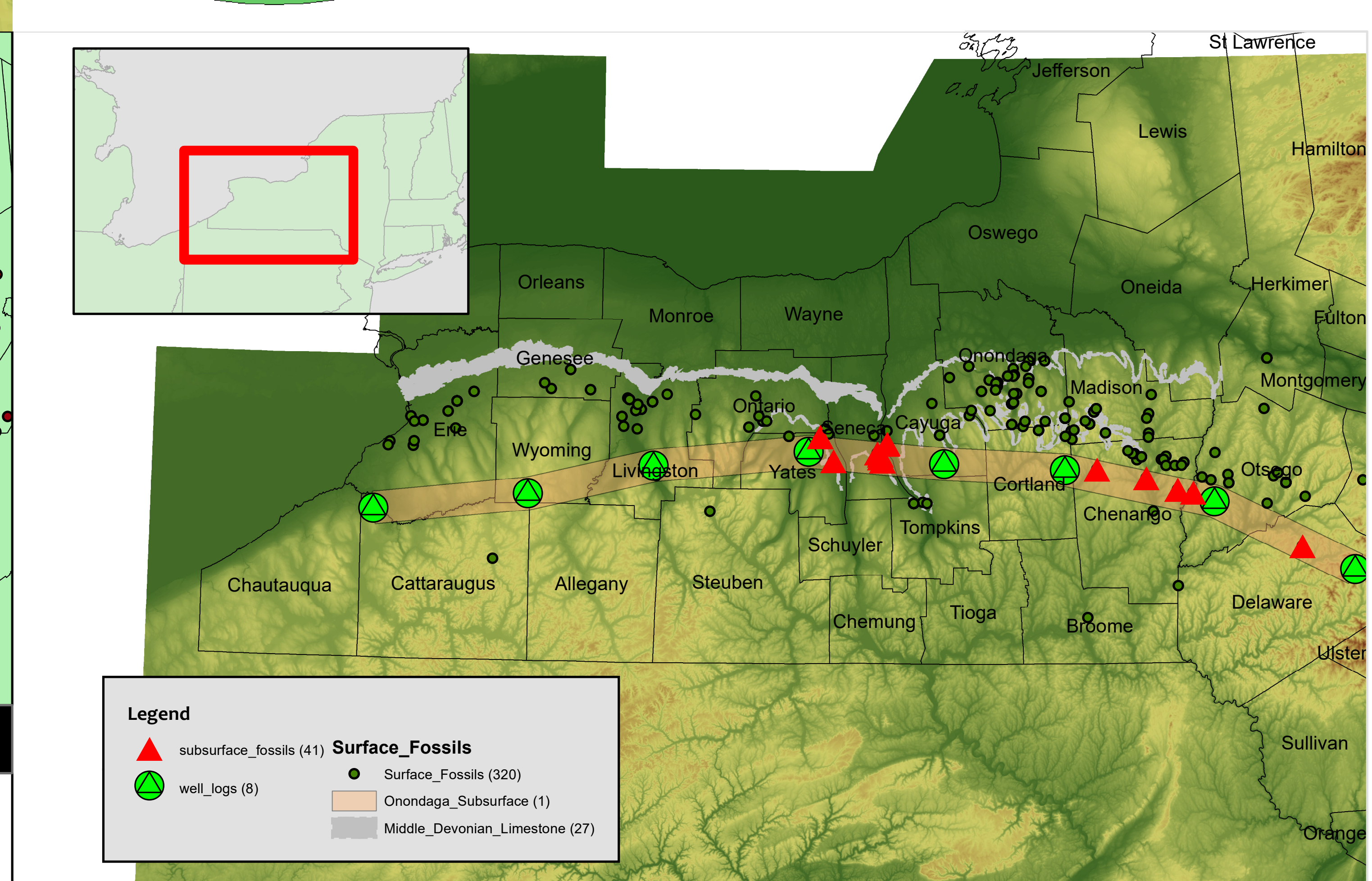


Figure 5: Displaying all known well borings in New York




## Summary and Conclusions

Based on the results of this lab, we can make a number of observations. First, we can see that the Onondaga is primarily beneath the Earth's surface, with only a few lines of outcrops in central New York. This means that fossil collection is primarily done in these areas, obviously not in the subsurface section. Any subsurface fossil collections were made through the use of geophysical borings and examining rock cores. Through these we can see how our extinct organism of interest is distributed in the subsurface formation. Based on the data provided, we cannot state that the subsurface Onondaga Formation does not contain a high density of Orthida fossils. More exploratory borings must be drilled in order to have a more concrete answer regarding the spatial distribution of fossils. Looking at the surface of central New York, outcrops created from meandering rivers have provided a location for excellent and simple fossil collection. This allows for paleontological studies to go underway.

## References, Acknowledgements, and Sources Cited

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Oil and Gas Well Data. 2016. wellDOS. New York Department of Environmental Conservation. Last accessed online on December 8, 2016 at