



3D Subsurface Mapping

By: Coty Withorn
cwithorn@lssu.edu



Abstract

This project was composed of creating a 3D subsurface map using ArcGIS and ArcScene. The program can be used as a new way to produce the subsurface maps without access to specific programs that are designed to just create surface and subsurface maps. The process of using ArcGIS can be done by taking the depths to the tops of the formations. This information comes from geologic well logs. Creating a Triangulated Irregular Network (TIN) in ArcGIS then expanding upon it in ArcScene are the steps in creating this type of map. The data analysis was done using ESRI ArcGIS, ArcScene and all of the program's extensions.

Introduction

The study area is the Lower Peninsula, which encompasses 41,342.15 Sq. Miles or 26,458,809.17 acres. The study area is a large part of the Michigan Basin which makes it a suitable area to look for oil and gas. The Lower Peninsula contains about 64,479 wells that deal with oil and gas in some form.

The goal of this project is to see it is possible to create a suitable map that shows the depth to formation and to possibly see a structural formation map. The depth to formation map is done by taking the depths to the top of the formations and creating a Triangulated Irregular Network (TIN). This gives a raster looking result in ArcGIS. Using the same TIN and opening it in ArcScene, you can make a 3D model which will create a probable model on how the subsurface looks by projecting to other bore holes. These models can help a driller and the geologist make accurate guess on how deep the target formation is.

There are other programs on the market which are designed to do the same thing and even better than ArcGIS. These programs include Petra and RockWare. Both programs can do subsurface modeling. Doing this in ArcGIS makes it possible to look at the subsurface layers when you don't have any access to specially designed programs.

Methods

Tools that were used:

- Raster Calculator
- Create TIN
- Hill Shade
- Join and Selection

Conclusion

It has been determined that it is possible to create a subsurface map by processing and selecting the proper set of data. This can be used to give a large scale subsurface geology map of Michigan. Although this may not be the best option to use, it is possible to create a successful map when you have no other geology mapping programs available, and a large set of data points to join and comb through ArcGIS and ArcScene. No future work will be needed.

Results

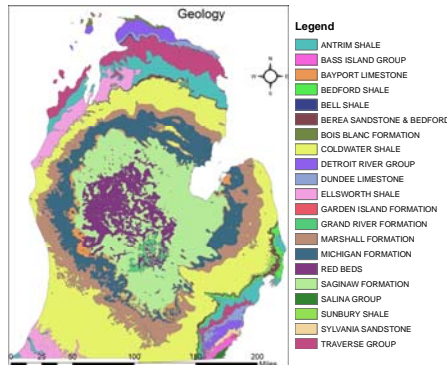


Figure 1
The figure above shows the State of Michigan Surface Geology.

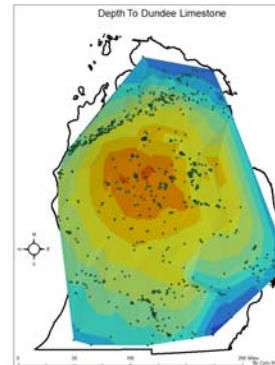


Figure 2
The figure above shows the 2D model and 3D model of the Drilling depth to the Dundee Limestone.

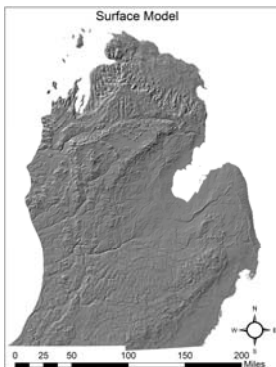
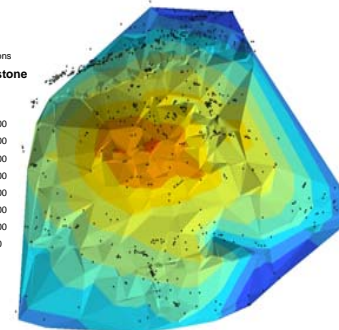


Figure 3
The Surface Model is to show topography of the State of Michigan and how it varies across the it.

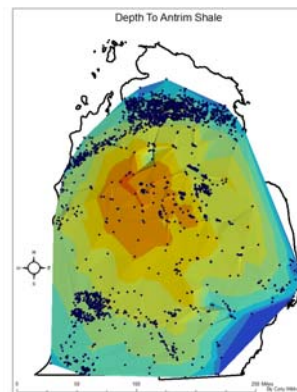
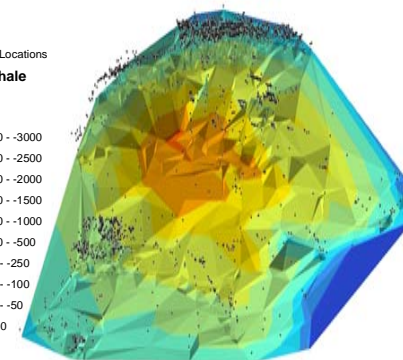


Figure 4
The figure above shows the 2D model and 3D model of the Drilling depth to the Antrim Shale.



Sources

- Michigan Geology - Michigan Center for Geographic Information Data Library (CGI)
- Oil and Gas Well Data - Michigan DEQ
- The Michigan Stratigraphic Nomenclature - Michigan DEQ