

# Syllabus: GEOL 315: Modern Methods of Geology

## Fall 2021

**Instructor:** Dr. Paul Betka

**Email:** [pbetka@gmu.edu](mailto:pbetka@gmu.edu)

Office hours: TBD

Class meetings will be held in EXPL 1005: F 1:30-4:10pm.

**Course Description:** An introduction to common types of datasets (i.e. [geologic map products](#), [reflection seismic data](#), [outcrop photogrammetry](#)) that geologists use in the workforce (both public and private sector) to complement field-based and observational methods of geology (such as outcrop, core or sample descriptions). The class will focus on both learning about the applications of the various data types as well as developing skills in accessing, plotting, and making geologic interpretations of the data.

### **Part I (8 weeks): Geologic maps and map products.**

Geologic maps represent the intersection of subsurface geology in 3D (4D actually, 3D + time!) with the topographic surface of the earth. A wealth of both quantitative and qualitative information can be gleaned by learning to read and interpret geologic maps. In Part I of the class you will learn to make geologic interpretations and extract quantitative data from geologic maps. I will also teach you basic GIS work flows for accessing open-source geologic map data (like [SRTM](#) (global) and [3DEP](#) (national) DEMs, as well as [USGS and Statemaps](#)) so you can learn to create your own geologic maps.

### **Part II (3 weeks): Outcrop digital datasets.**

Over the past decade or so, advances in digital photography, remote sensing equipment, and consumer computer processing power have led to the development of very-high resolution (mm-scale) digital outcrop models using tools like [Gigapans](#) (2D) and outcrop [photogrammetry](#) (3D) and [LiDAR](#). What used to be prohibitively expensive imaging equipment for most field-geologists is now readily available on consumer products, opening up a wealth of possibilities for the geologist interested in high-resolution quantitative datasets. Part III of the class will focus on geologic applications of modern digital field techniques, including an introduction to tablet and smartphone-based geologic mapping apps like [StraboSpot](#) and [FieldMove](#).

### **Part III (3 weeks): Subsurface datasets.**

Many professional applications of geology rely heavily on subsurface datasets for understanding economic or environmental impacts of geologic resources (e.g. groundwater, hydrocarbons, mineral resources). Part II of the class will focus on introducing common types of subsurface datasets including seismic reflection images and depth/thickness maps.

**Assessment:** The final grade for this class will be a combination of class participation and weekly assignments. As this is a data and skills focused there are no tests, mid-term, or final exams. Graduate students (GEOL 500) will be expected to carry out a semester research project in addition to completing all of the GEOL 315 assignments.

**GEOL 315:**

**Weekly homework assignments (14).....100%**

Assignment score (80%), participation score (20%).

**Grade scale:**

A+ = 97 - 100%, A = 94 - 97%, A- = 90 - 94%, B+ = 87 - 90%, B = 84 - 87%, B- = 80 - 84%, C+ = 77 - 80%, C = 74 - 77%, C- = 70-74%, D = 60 - 70%, F = 0 - 60%

**Please note: Late work will not be accepted, no extra credit.**

**DISABILITIES:** Students with disabilities or medical conditions that affect classroom performance should contact GMU Disability Support Services immediately at 993-2474. NOTE: Students will not receive any disability accommodations unless official GMU paperwork from Disability Resource Office is provided for and signed by Dr. Paul Betka.

**HONOR CODE:** Adherence to the GMU honor code is expected of all students. Lab exercises are expected to be individual efforts, unless teams are specifically assigned. Students are encouraged to discuss the concepts and procedures among themselves, but each student is expected to complete the lab assignment individually using their own words.

***To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University Community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this Honor Code: Student Members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.***

[\[http://academicintegrity.gmu.edu/honorcode\]](http://academicintegrity.gmu.edu/honorcode)

<b>Week</b>	<b>Friday class</b>	<b>Assignment</b>
<b>1: Aug. 27</b>	<b>Syllabus; Lect. 1 Map basics, strike and dip, topography.</b>	University of Leeds, 3D exercises. Strike/Dip, Strike lines, Rule of Vs.
<b>2: Sept. 3</b>	<b>Geologic mapping and field basics</b>	Lighthouse Bay mapping assignment
<b>3: Sept. 10</b>	<b>Geologic cross sections and 3D map problems</b>	Lighthouse Bay cross section
<b>4: Sept. 17</b>	<b>Digital map data types, map projections. QGIS</b>	Install QGIS v. 3.10. Load West Virginia data, experiment with map projections and measurements.
<b>5: Sept. 24</b>	<b>Grand Canyon project wk 1</b>	Download Grand Canyon datasets, load in QGIS.
<b>6: Oct. 1</b>	<b>Grand Canyon project wk 2</b>	Grand Canyon stratigraphic section
<b>7: Oct. 8</b>	<b>Grand Tetons Project wk 1</b>	Download Grand Tetons datasets, load in QGIS
<b>8: Oct. 15</b>	<b>Grand Tetons Project wk 2</b>	Teton Fault scarp map and cross section
<b>9: Oct 22</b>	<b>Digital geological mapping</b>	Neighborhood digital mapping exercise
<b>10: Oct. 29</b>	<b>Organizing digital datasets for GIS</b>	Plot neighborhood mapping data in QGIS
<b>11: Nov. 5</b>	<b>Digital outcrop data</b>	Photogrammetry demonstrations
<b>12: Nov. 12</b>	<b>Introduction to subsurface datasets and seismic reflection</b>	Subsurface datasets 1
<b>13: Nov. 19</b>	<b>Isopach, Isochore, and Isochron maps</b>	Subsurface datasets 2
<b>14: Nov. 26</b>	<b>Thanksgiving Break</b>	
<b>15: Dec. 3</b>	<b>Resource exploration using subsurface data</b>	Subsurface datasets 3