Guided Activity: Maps
Sproul State Forest Fieldwork
July 19, 2015

This activity is designed to walk you through the process of using maps and aerial photography to identify areas of historic oil and gas development. The resources that are useful in this effort include United States Geological Survey (USGS) geologic and topographic maps, Works Progress Administration (WPA) Bituminous Mining Maps, and aerial photography.

Part I: USGS Geologic Maps

It is often best to begin with the USGS geologic maps, as this resource will outline the general geology of the region. A geologic map depicts the rock units exposed at the surface by using a different color or symbol for each rock unit. The USGS has published four different surveys of geologic maps, each covering a different interval of time. Choose a geologic map created during a time period similar to the time of historic oil and gas development you wish to investigate.

First Geological Survey (1874 to 1899)
Second Geological Survey (1874 to 1899)
Third Geological Survey (1899 to 1919)
Fourth Geological Survey (1919 to present)

Since we will be focusing on the geology of Sproul State Forest during the late 1800s during this exercise, take a look at the USGS Second Geological Survey map of Clinton County.

Notice the legend in the top right corner, which matches a different rock unit with a different color. The rock units are arranged in order of age. Based on the topography of the map and the fact that rock units are deposited in layers with the oldest layer on the bottom and the youngest layer on the top, answer the following questions.

Q1: Which rock unit is the oldest? Why?

Q2: Which rock unit is the youngest? Why?

Historic oil and gas development generally exploited what is known as conventional oil and gas reservoirs. In contrast to the unconventional oil and gas reservoirs being explored today (shale gas, oil sands, coal bed methane), conventional oil and gas reservoirs occur when oil or gas accumulates in a rock unit of high porosity, such as a sandstone unit, that is sealed from above by a rock unit of low porosity, such as a shale unit (see Figure 1.1). Additionally, in conventional reservoirs, oil and gas tends to accumulate in geologic structures called anticlines, which are created by the folding of the rock layers into a dome-like shape (see Figure 1.1).

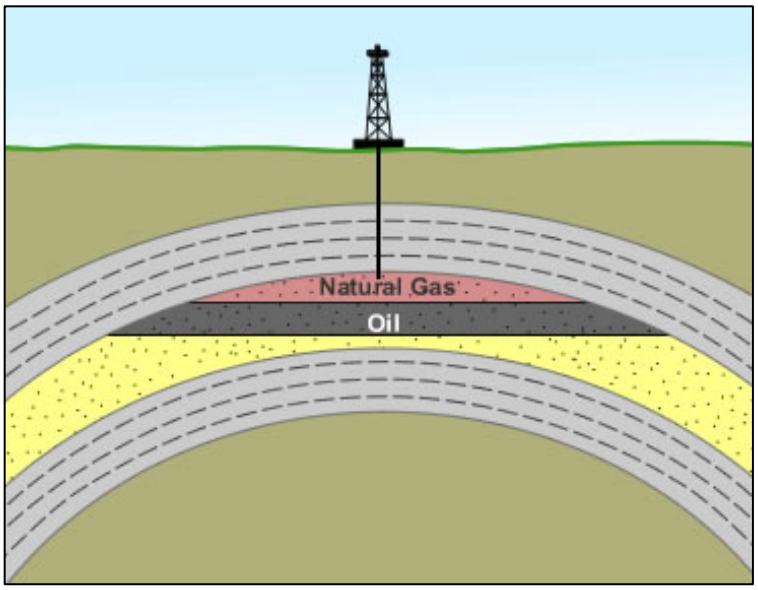

Figure 1.1: Schematic of conventional oil and gas reservoir. Notice the accumulation of oil and gas in the high porosity sandstone layer (shown by the dotted layer) and the trapping of the oil and gas by the low porosity shale layer (shown by the dashed layers). The oil and gas is trapped in a geologic structure known as an anticline.

During the late 1800s to early 1900s in the Sproul State Forest Region, the Catskill Red Sandstone was exploited as a conventional oil and gas reservoir which was sealed by the Chemung Shale. Take a look at the Second Survey USGS map again to answer the following questions.

Q3: What color is the Catskill Red Sandstone Unit?

Q4: Describe the distribution of the Catskill Red Sandstone.

In the Sproul State Forest region, the Catskill Red Sandstone is concentrated in the Hyner Run Region along the West Branch of the Susquehanna River. This area is the top of an anticline that has eroded away to expose this unit at the surface. We will focus the rest of our research in this area since we know it is a rock unit that was historically developed for oil and gas and that it is located at the crest of an anticlinal structure (which promotes the accumulation of oil and gas).

Take a look at the Renovo East Quadrangle USGS Geologic Map. This map depicts distribution of geologic units by unit name abbreviations rather than colors in the Hyner Run Region at higher resolution than the Second Survey USGS map. Notice that the Catskill Red Sandstone unit is denoted by the abbreviation “Dck” and that the crest of the Hyner anticline is denoted by a straight line with two arrows extending away from the line.

Q5: In this higher resolution USGS geologic map, describe the distribution of the Catskill Red Sandstone.

Q6: Where does the crest of the anticline intersect the Catskill Red Sandstone Unit?

It is likely that the area where the anticline intersects the Catskill Red Sandstone, is an area of historic oil and gas development. Let's continue to explore this with other resources.

Part 2: WPA Mining Maps

The WPA Mining Maps were created in the 1930s as part of President Roosevelt's New Deal public works program. The purpose of these maps was to describe the distribution of bituminous coal seams and mines throughout Pennsylvania. In the interest of exploring historic oil and gas development, these maps can be useful because they often show the locations of oil and gas wells denoted by small stars or circles (see Figure 2.1).

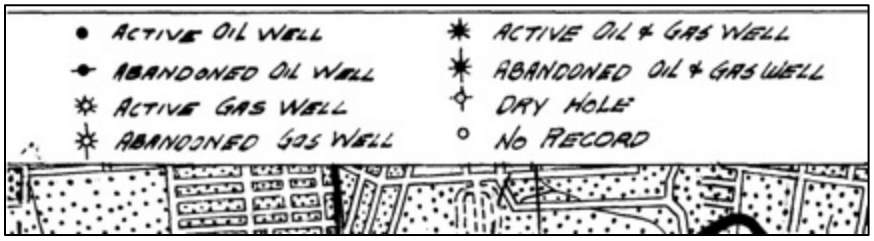

Figure 2.2: Legend of a WPA Bituminous Mining Map denoting the symbols for active and abandoned oil wells, active and abandoned gas wells, active and abandoned oil and gas wells, and dry holes.

Although we are exploring historic oil and gas development in the Hyner Run region during the late 1800s and early 1900s and the WPA Mining Maps were created in the 1930s, it is still valuable to consider if oil and gas development continued in this region between the two time periods. Often, areas of oil and gas development are developed in discrete intervals over long periods of time. Take a look at the WPA Mining Maps for the Hyner Run region.

Q7: Do you notice any signs of historic oil and gas development on the WPA Mining Map?

Although there are no signs of active or abandoned oil and gas wells in the WPA Mining Maps for the Hyner Run region, let's continue to explore other resources.

Part 3: Penn Pilot Aerial Photography

Penn Pilot is an online database of digitized historic aerial photography of Pennyslvania supported by the Pennsylvania Geologic Survey. The website provides an interactive map of Pennsylvania that allows you to zoom-in to the area of interest and explore aerial photographs

during three different time periods (1937 to 1942, 1957 to 1962, and 1967 to 1972). Aerial photographs can be useful in the search for abandoned wells because they can be used to identify old access roads, well pads, oil rigs, and other signs of historic oil and gas development.

The time period covered by the Penn Pilot aerial photography does not correspond with the time period we are exploring from the late 1800s to early 1900s. However, similarly to the WPA Mining Maps, it is valuable to note if there are signs of oil and gas development during multiple time periods as areas are developed in discrete intervals over long periods of time.

Take a look at the 1938 Penn Pilot aerial photograph of the Hyner Run area from the 1937 to 1942 time period.

Q8: Do you notice any surface expressions of development? If so, describe.

Take a look at the 1959 Penn Pilot aerial photograph of the Hyner Run area from the 1957 to 1962 time period.

Q9: Do you notice any surface expressions of development? If so, describe.

Take a look at the 1968 Penn Pilot aerial photograph of the Hyner Run area from the 1967 to 1972 time period.

Q10: Do you notice any surface expressions of development? If so, describe.

As you progress through the aerial photographs, notice changes in land development over time.

Part 4: References

USGS Maps
http://www. nationalmap.gov/ustopo/
http://www.libraries.psu.edu/psul/emsl/paresources/pacounty.html

WPA Mining Maps
http://www.minemaps.psu.edu/

Penn Pilot
http://www.pennpilot.psu.edu/