Name:___________________________

Lab #03
Interpretation of "false-color" Aster Images
Feb. 14, 2018   Remote Sensing 4113/5113

Equipment: Calculator, map, rule, protractor, pens, acetate overlay, drafting tape, and provided images and maps.

Introduction:

The purpose of today's lab is to learn to interpret Visible and Near-Infrared (VNIR) false color images, and to recognize different features such as vegetation, roads, streams, and different rock types. While we'll eventually do this using more automated techniques on the computer, today's lab should acquaint you with the basic patterns we'll be looking for.

Figures 1 and 2 are an overview and more detailed image of the Red Canyon area south of Lander, on the SE flank of the Wind River Mountains. They were obtained with the Aster instrument on the Terra satellite. The three channels displayed as B, G, R, are 0.52 – 0.60 μm, 0.63 – 0.69 μm, and 0.76 – 0.86 μm, very similar to the bands 2, 3, and 4 (green, red, and near-IR) on the Landsat Thematic Mapper. The resolution however is a better 15 meters. (Later on we'll be discussing more advanced features of Aster.) Figure 3 is a map corresponding roughly to the area in Figure 2, and Figures 4 and 5 are photographs taken from location A on the map, looking NNW up Red Canyon. Figure 6 is a roughly southwest to northeast cross section of the rocks exposed in this area. The sedimentary rocks were originally flat lying, but they were tilted as the Wind River Mountains rose to the southwest, then they were eroded. Their different resistance to erosion largely determines the topography, with more resistant rocks such as sandstones forming ridges while less resistant rocks form shallow slopes or valleys.

<u>Note: While the following pages just gives places to fill in answers, you will want to attach another sheet of paper showing the calculations you used to derive them.</u>

Place acetate overlays on Figures 1 and 2, and in the following questions please mark the overlays rather than the images themselves. Mark the corners of the images on your overlays, so they can be aligned later. Also, label your overlays outside the image areas. Use the map to determine the direction of true north, and mark this direction with an arrow near the upper right corner of your overlays. Note the images may not be aligned exactly N-S.

Part 1. Scale

1. Use the UTM marks on the map to determine the scale of the map. Then identify common features on the map and Figures 1 and 2, and determine the scale of those figures.

Some features which may be useful are:
"Dry Lake", near the top of the map and Figure 2, and near the middle (slightly left) on Figure 1.
The two drainages N and S of Dry Lake, both trending NE.
The highway intersection just south of Dry Lake, and Highway 28 itself as it winds SW.
It is hard to see in Figure 1, but you may be able to pick it out after examining Figure 2.
The "Columbia-Geneva Mines" near the southwest corner of map and Figure 2.
Note in the images the mine has a much bigger tailing pond than is shown in the older map, and the area around the tailing pond is blue-gray.
Beaver Creek drainage, trending NW-SE, located about 5 km NE of the mine,

1a. Map Scale 1:_________________

1b. Figure 1 Scale 1:_________________

1c. Figure 2 Scale 1:_________________

Part 2. Image orientation and lighting geometry

First we need to find the direction of north on the images. Remember that Terra and other sun-synchronous satellites do NOT pass over the earth on a true north-south track, so the edges of the image will most likely <u>not</u> be oriented exactly north-south. However the edges of this map <u>will</u> be true north-south. Using the map find two clearly recognizable and well separated points which you can also see on both of the images. Draw a line between those points on the map overlay and on the image overlays. On the map measure the azimuth of that line, in degrees east-of-north. This is the <u>true</u> azimuth. Next, on both image overlays, starting with the lines between the points and the true azimuth value you just measured, use your protractor to find, draw, and label lines which represent true north. Then measure and fill in below how far off (in degrees) from true north-south the edges of the images actually are..

2a. Image edge azimuth: Figure 1: _________________

Figure 2: _________________

Lighting geometry also has important implications for interpreting images such as these. Look at the clouds and their shadows visible near the south edge of the overview Figure 1. For several clouds identify unique features in them and the corresponding features in their shadows. Mark on your Figure 1 overlay lines connecting these points. Using an average result from those lines, measure with a protractor the azimuth direction the sun is shining from, again in degrees east-of-north. Next, using the <u>crude approximation</u> that the sun rises due east at 6AM, is due south at noon, and sets due west at 6PM, and moves uniformly over those 180^o in 12 hours, estimate the time of day when these observations were taken. (With a more accurate formula for motion you could use this natural sundial to determine time precisely.) Aster is in an orbit very similar to Landsat 7. Does the time you get below agree with what you know about Landsat overflight times?

2b. Solar azimuth direction: _________________

2c. Time of day: _________________

Next, use the length of the lines you drew and the scale of Figure 1 to determine the horizontal offset between the clouds and their shadows. Assume the clouds are at an altitude of 3000 m above the ground. Use your estimated horizontal offset and simple trigonometry to determine the elevation of the sun above the horizon, in degrees. (Note with the appropriate tables or more complex formulae you could also use this elevation to determine the time of day.) Think about whether the elevation is roughly consistent with the time determined above.

2d. Solar elevation: ______________ degrees

Part 3. Classification of individual rock units

3. Examine Figure 2 and on the overlay over it, map the following:

3a. Outline 8 to 10 different rock units.

3b. On a couple of the most prominent units mark which part is the dip slope and which part is the anti-dip scarp. On the dip slope use the standard symbols to indicate the strike and dip of the rock beds.

3c. The most prominent dip slope visible in the cross section of Figure 6 is the Phosphoria Formation, marked Pp. Try to recognize it and the recent "Alluvial Deposits" (Qa) in the photographs (Fig. 4 and 5) and in Figure 2. If you haven't already done so, outline these two regions on your overlay of Figure 2, and label them.

3d. Using these as a starting point and the Figure 6 cross section as a guide, try to identify and label (tentatively) the other prominent rock units you outlined in section 3a. these will clearly be tentative identifications given the scale of the image. Use the steepness of the slopes, and the colors of the formations (properly translated to "real values") as a guide.

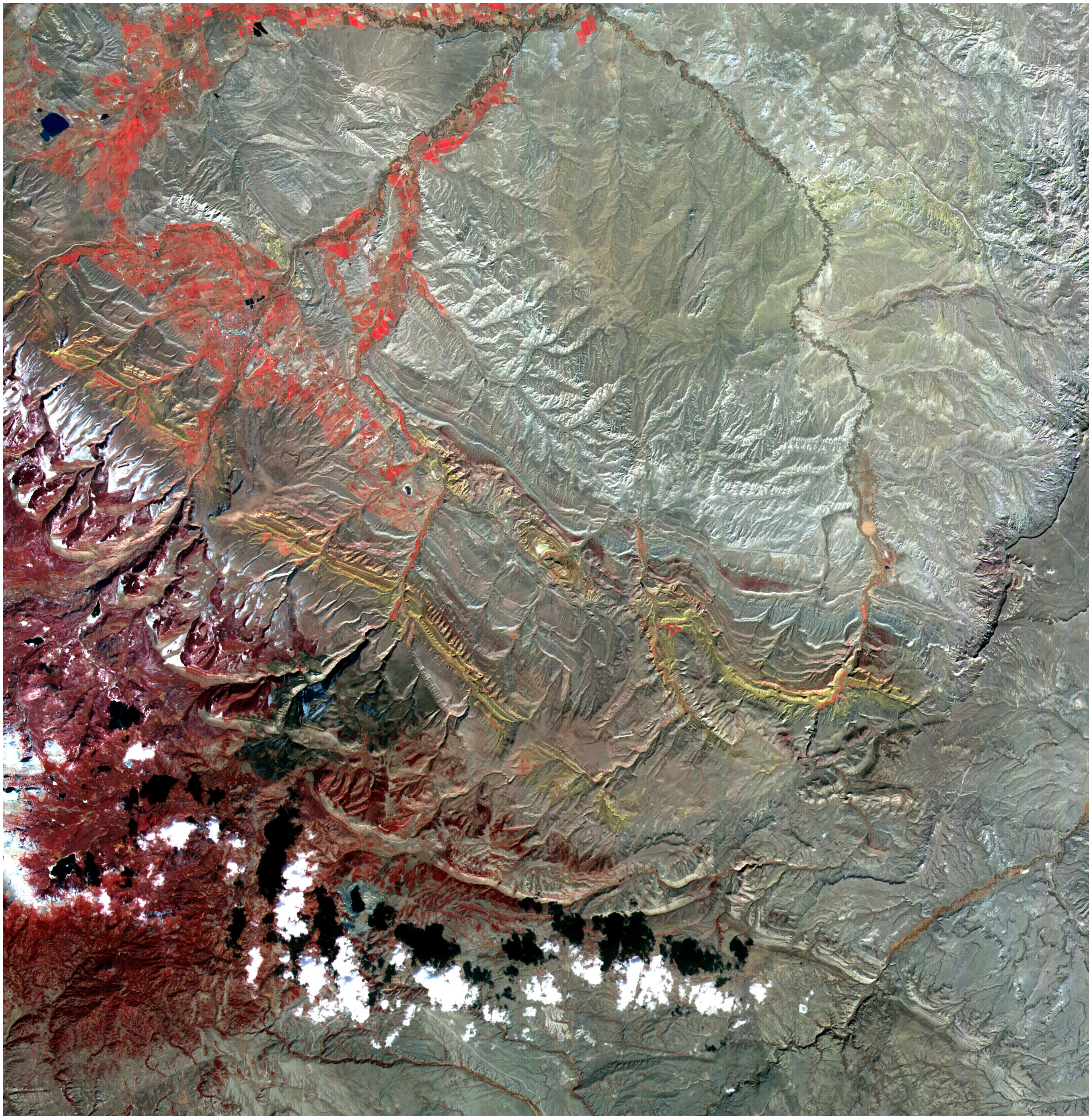


Figure 1. Overview of the SE flank of the Wind River Mountains
Aster VNIR Image

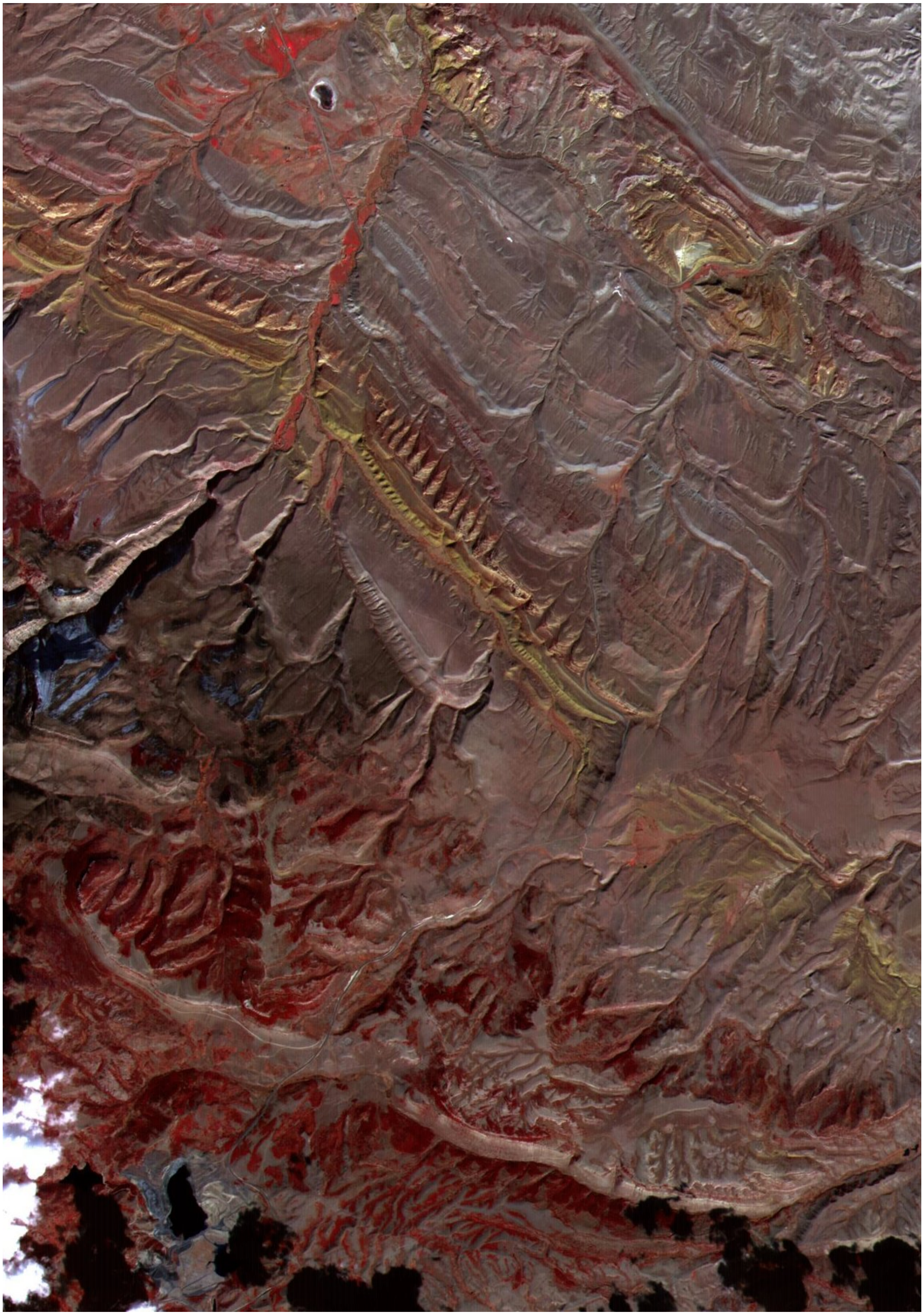


Figure 2. Expanded view of Red Canyon on SE flank of Wind River Range
Aster VNIR Image 2% Linear stretch

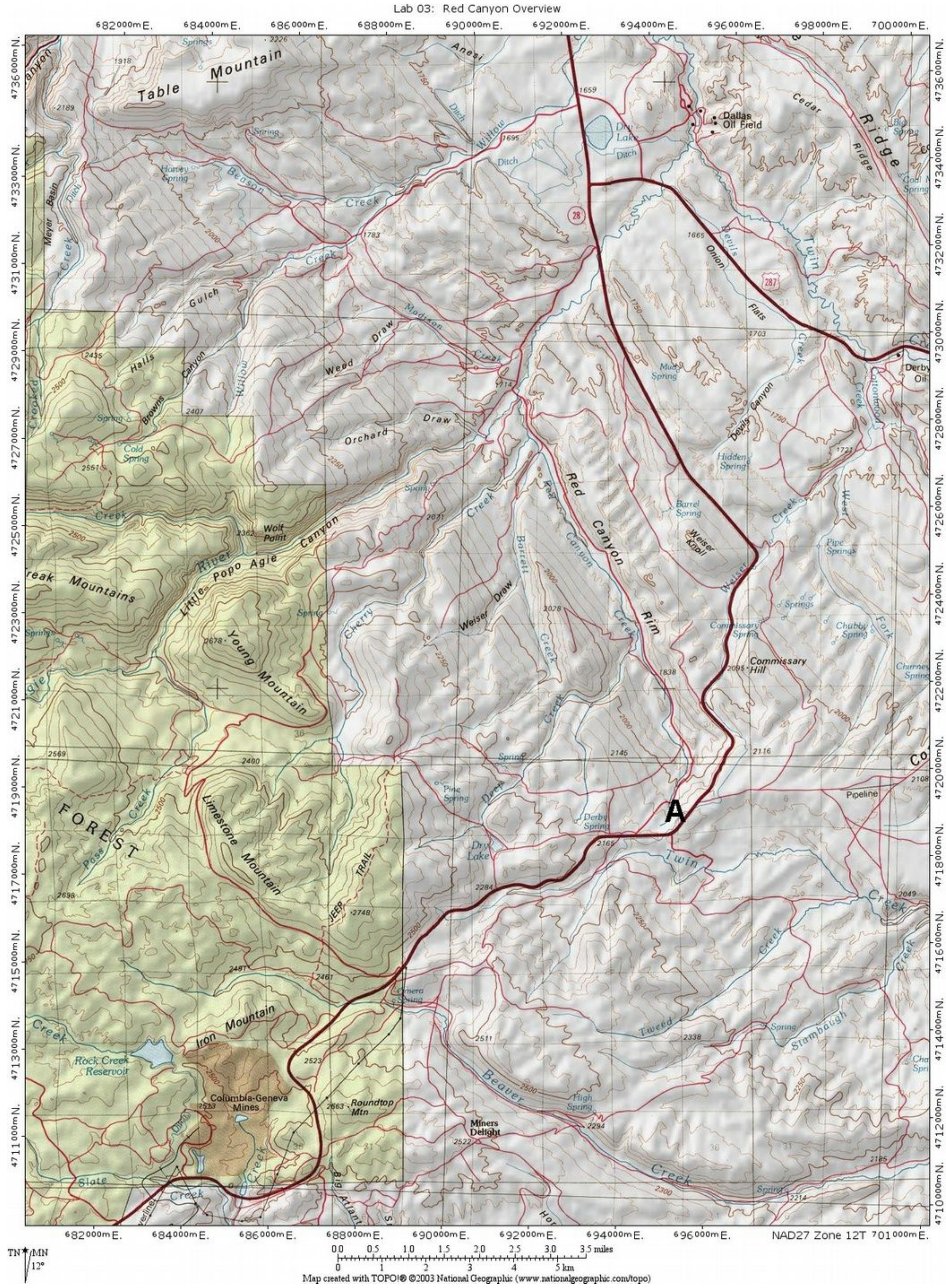
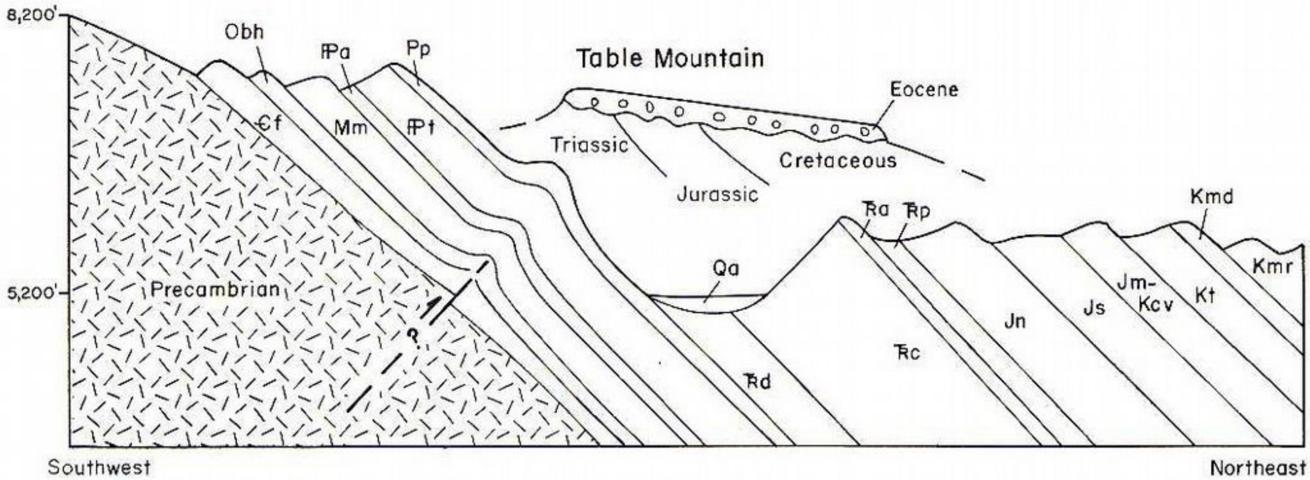


Figure 3. Overview map of SE flank of Wind River Range

Figures 4 and 5. Photographs looking from point A on the map, NNW up Red Canyon.



EXPLANATION

Quaternary

Qa	*Alluvial deposits*

Cretaceous

Kmr	*Mowry Shale*
Kmd	*Muddy Sandstone*
Kt	*Thermopolis Shale*
Kcv	*Cloverly Formation*

Jurassic

Jm	*Morrison Formation*
Js	*Sundance Formation*
Jn	*Nugget Sandstone (base is Triassic)*

Triassic

TRp	*PopoAgie Member, Chugwater Formation*
TRa	*Alcova Limestone and Crow Mountain Sandstone, Chugwater Formation*
TRc	*Red Peak Member, Chugwater Formation*
TRd	*Dinwoody Formation*

Permian

Pp	*Phosphoria Formation*

Pennsylvanian

IPt	*Tensleep Sandstone*
IPa	*Amsden Formation*

Mississippian

Mm	*Madison Limestone* Figure fr

Ordovician

Obh	*Bighorn Dolomite*

Cambrian

€f	*Flathead Sandstone and other Cambrian rocks*

Fault; arrow indicates direction of movement; inferred where dashed.

Figure 21. Schematic cross section of the southeast flank of the Wind River Range and western Wind River Basin, looking northwest from the head of Red Canyon. Section is about 11 miles across, and vertical relief at the surface is about 3,000 feet. Elevations are in feet above mean sea level.

Figure from Mears et al. 1986, Wyoming Geological Survey Public Information Circular #27

Figure 6. A southwest to northeast cross section of Red Canyon and adjacent areas.