**GIS Exercise 10**
**March 30, 2018**
**The USGS NCGMP09v11 tools**

As a result of the collaboration between ESRI (the manufacturer of ArcGIS) and USGS, ESRI released its Geologic Mapping Template (GMT) in 2009 which we used last week, designed to create geologic maps in the new NCGMP09 "standard". Unfortunately they haven't updated the tools since then either to accommodate new versions of ArcGIS, or to include features left out of the original version.

In the mean time USGS has released newer versions of its Toolbox, including one in 2016. (Most of the tools show a late 2015 version date). In some ways it is less complete than the GMT, for example containing fewer classes of features and fewer symbols than in GMT. However as it is continuing to be developed, it is a better choice for the long-term. Like the GMT it has a tool for generating a new "blank" geodatabase in the NCGMP09 arrangement. However that "standard" is a moving target and a number of details in the files created are different between the two versions. That means many tools from one Toolbox will not be able to work with files generated by the other Toolbox. On the other hand the USGS version does have a few features that the GMT lacks. For example it has a method for exporting the data into non-ESRI shapefile format, although some "meta-information" is lost in the process.

The overall pattern for this exercise is the same as Exercise 09 with the ESRI GMT Toolbox, but the details are different.

The USGS tools can be obtained from their website <http://ngmdb.usgs.gov/Info/standards/NCGMP09/> but I've included a copy in the Exercise 10 data zip file too.

**IMPORTANT NOTE ADDED 2018_03_30**

Their latest tool is not working correctly in our ArcMap 10.5 so in the exercise_10 zip file I've included their tool from a few years ago which does, after a couple kludge workarounds described later, seem to work in ArcMap 10.5 . Use that older tool rather than the newer 2015/2016 one until this problem is solved.

From the class website download the exercise_10 zip file and unzip it. Within it you will find a **NCGMP09v1.1_Tools2_Arc10.1.zip** file. (Note this is the name of the older tool. Their newer tool, **NCGMP09v1_Toolbox3b,** as mentioned above, has problems in ArcMap 10.5) Unzip it as well. Look briefly inside that new unzipped NCGMP directory. You will see the ArcGIS toolbox (**.tbx** file) itself, plus a subdirectory of documentation about the tools, and a subdirectory of scripts which will be called FROM the toolbox. Don't move the scripts after installing the toolbox or ArcGIS will get confused.

Start **ArcMap**. Don't actually create or open a new map – just hit cancel when it asks to do that. Open the **ArcTooxbox**. Right click inside it, select **Add Toolbox**, then navigate into the folder where you've unzipped the NGCGMP09 tool and add that tool.

Within **NCGMP09 Tools**, double click on **Create New Database**. In the dialog which opens for **Output Workspace** click on the folder icon and select the **exercise_10** folder. For the **Name of new geodatabase** type **exercise_10**. For **Spatial reference system** click on the Pick icon and select
**Projected Coordinate Systems / UTM / NAD 1983 / NAD 1983 UTM Zone 13N.**

The next step lets you add optional feature classes to the database. (The ESRI tool just tends to add ALL the feature classes, whether you need them or not. Also, the NCGMP tool has a few more useful classes, like GeochronPoints, FossilPoints, etc. For the following, just add **MapUnitPoints**. which we will use for marking our different unit polygons. The USGS tools **can** use a simpler system for keeping track of feature types and symbols than ESRI, but it can also adopt the ESRI mode of using "Representations" to hold classes of symbols, and also uses **FGCDRefNo** rules to determine the which symbols are used for different features. However it does this in a slightly different way, avoiding the explicit columns of **FGCDRefNo** values. In this example we'll use that method. Check the
**Add fields for cartographic representations** box near the bottom of the dialog. (You may need to scroll down in the dialog to see it.) Finally, click **OK**. The tool may take several minutes to run, and a progress window reports as it adds classes of features. However it **will** be faster than the ESRI version. When it is finished **Close** the progress dialog window.

Back in the main ArcGIS window from the main menu use **File / New** to create a new map. Use the default **Blank Map Template**, but for at the bottom of the dialog window, for **Defaultgeodatabase** select the just created **exercise_10.gdb**. Our first step is to right click on **Layers** and using **Add Data**, add the **ContactsAndFaults** feature from within the database we just created. We can skip the step of defining the **Coordinate System** for the **Data Frame** which we performed in Exercise 10, because we've already set up this **ContactsAndFaults** layer to use **NAD 1983 UTM Zone 13N**, and ArcGIS will adopt for the **Data Layer** the coordinate system of the first layer added.

Open the **ContactsAndFaults** attribute table and examine the columns this USGS tool creates. While similar to the ESRI one, there are differences. One addition is that (if we use the default settings above) it creates columns which keep track of the last time any feature has been edited.

Next lets add the Laramie tiff map as a basemap. Once again right click on **Layers**, select **Add Data**, then select the Laramie map included in the exercise data. If it offers to build pyramids, do that. If requested, add transformation (**NAD_1927_To_NAD_1983_NADCON**) as described in the previous exercise, to convert from the map's NAD27 to NAD83 used in our geodatabase.

Next, add the **rrh_land_addition_boundaries** shapefile to the map. You may again need to add a transformation, this time telling it that to convert from **GCS_WGS_84 to GCS_NorthAmerican-1983** it should use **WGS_1984_(ITRF00)_To_NAD_1983_HARN.** We will also need to do some further processing before adding it to the geodatabase. We have a polyline for each addition area, and that means, where the polylines touch, we actually have two overlapping (in fact exactly coincident) line segments, one from each of the original polygons. It turns out the NCGMP tools are not flexible to understand this and will complain we have two contacts on top of each other. The following steps eliminate the problem.

To remove duplicate “contacts” we will convert the polylines to line segments then (for simplicity in this exercise) manually remove the overlapping segments. In ArcToolbox use the **Data Management Tools / Features / Feature To Line**. In the window which opens for **Input Features** select **rrh_land_addition_boundaries** . For **Output Feature Class** use the file selector icon to navigate to the **exercise_10.gdb** geologic map and enter the feature name as **rrh_land_addition_contacts**. Leave the other options set at their default and click **OK**. After several seconds a new layer

should be added to the map. Open its attribute table. You may also want to turn off display of the other layers and zoom to this layer to see it clearly. Turn on editing for this layer using the **Editor** toolbar and ignore any warnings about coordinate systems. Step through the attribute table selecting each feature by clicking on the empty first column, and you should see the line segments highlighted. There will be three interior contact lines which have duplicates. Delete those duplicates so there is only one copy of each contact. When finished use the Editor Toolbar to **Stop Editing** editing and save the result. You can then close the attribute table. There are more automated processes to detect duplicates if you have a large number, but with just three, for this exercise it is simpler to fix it manually.

The NCGMP toolbox doesn't have a tool for importing other datasets into its contact feature set, but we can use the one from the ESRI Geologic Mapping Tools. Add that toolbox (from the previous exercise data folder) if it is not already present. Within that double click on **Append ProjectESRI_Geology.gdb ,** for **Original Feature Class** select **rrh_land_addition_contacts** and for **Project Feature Class** select **ContactsAndFaults**. In the **Field Map (options)** panel right click on **Notes**, add as an **Input field** the **Year Added** column from our shapefile. Then in the main dialog click **OK**, and when the status dialog reports success, close that status window. The new contacts should have been added to your map.

Turn off all displays except for the new **ContactsAndFaults**, and zoom to it.

Open the **ContactsAndFaults** Attribute table, and start editing it. For each row first select it to make it visible then click on the **RuleID1** column. A dropdown box should give you the choice of line type to display the contact. Choose **1.1.1** for all contacts except for the western Laramie one. For the latter choose **1.1.5**. Then tell ArcGIS to **Stop Editing**, and save the changes.

Next we need to add a **MapUnitPoint** in every one of the regions which will become a geologic unit polygon. We'll add identifying information to its attribute table, and the NCGMP tools will use that to construct the map. Right click on **Layers / Add Data** to add the **exercise_10.gdb/MapUnitPoints** to the map. Enable editing of this layer then click on the **Create Features** icon in the edit toolbar, usually at the far right. The **Create Features** panel which opens, but at least sometimes in **ArcMap 10.5** before we can add any features, we need to create a

"Template" for the features to be added to **MapUnitPoints**. Scroll down to the bottom of the panel on the right showing templates. If it does in fact show a subpanel for adding **Points** in the **MapUnitPoints** layer you can skip the next step. If that template is not visible, create one as follows.

In the templates panel click on the **Organize Template** icon near the top. In the dialog which opens select the **MapUnitPoints** layer then click on **New Template. In the next dialog which opens select the default parameters then click on Finish.**

Add a point to each of the eight regions in the map (including the external region surrounding all the explicit polygons). When done, open the attribute table. You need need to enter a **Map Unit** value for each region. Use **Qa, Qb, ... Qe,** for the five regions making up most of Laramie and West Laramie north of Spring Creek, and use **Qf** for both of the land additions south of Spring Creek. (Note it would be quite common to have different exposures of the same geologic unit.) Finally, use **Qg** for the area surrounding the town. When finished **Stop Editing** and save the result.

Finally we are ready to tell NCGMP to take the contacts plus the above **MapUnitPoints** and create a set of Polygons which will correspond to all the exposures of geologic units. In the NCGMP Toolbox run **MakePolys**. It will ask you where to find the data set. Use the folder icon to select **exercise_10.gdb/GeologicMap** then click **OK**. While this more-or-less worked in earlier version of **ArcMap 10.x**, in **ArcMap 10.5** you will probably get an error about a **Locked Database**. If that happens, see the next paragraph about how to work around this error, then try again. In addition to the Lock problem, even in earlier versions of **ArcMap** there seems to be some minor bug in the program in that it may run till it says **Completed Successfully** then give an obscure message about **Forcing Exit with Error**. If it does get that far ignore the error message, click **Close** as it has probably actually worked. That will take you back to the first dialog of the tool where you can just click **Cancel**.

*Steps to work around the **ArcMap 10.5 Locked Database** error:* If the **Locked Database** error does occur, the error box should list the line were the first error occurred, probably line 167, in the **MakePoly** python file. Note there may be other error lines reported later in the message, but it is the first one which counts. Write down that first line number. Close the dialog box then back in the **ToolBox** list right click on **MakePoly** and select **Edit**. That should open up an editor showing **MakePoly's**

Python code. On Windows that editor will be **Notepad** and by default it does not show line numbers. To see those numbers select **View / Status Bar** from the **Notepad** menu. Scroll down till you find line 167, or whatever was listed for the error. (The **Notepad** status bar won't update line numbers after scrolling until you actually click on a given line.) That line should contain the statement **quitInError()** . To work around the error, comment out that line and the two above it by adding the comment character (**#**), to the start of each line. When finished they should look as follows:

```
# if not arcpy.TestSchemaLock(fds):
#    addMsgAndPrint('Feature dataset '+fds+' is locked!')
#    quitInError()
```

Save the file, exit **Notepad**, and rerun the **MakePoly** tool as described above. You will probably get the spurious error message after it says **Successful Completion** but it actually does create the proper polygons.

Back in the main map, add the **MapUnitPolys** to the map. These should in fact duplicate the polygons we started with long ago -- but now they are entered in the map in the proper NCGMP format, tied to the **ContactsAndFaults**. Examine the Attribute Table and you should see the **Qa, Qb,** etc. names we entered for the points. In a real geologic map we would use those values to control the display colors for the polygons, by way of the **DescriptionOfMapUnits** table. However as in this exercise we haven't created that table, we'll find a simpler way. Right click on **MapUnitPolys**, select properties, and in the window which opens select the **Symbology** tab. ArcGIS will be using the default **Features/Single Symbol** style. Change that to **Categories/Unique Values**. Set the column which controls the display to **MapUnit**, then click **Add All Values**. Use default values for the rest of the settings. Finally, go to the **Properties / Display** tab and set the transparency to 25%, then exit the **Properties** dialog.

To clean up the display, remove any left-over shape files. You might also want to turn off the display of the **MapUnitPoints**. You should now have a display which properly shows the contacts, the colored polygons, and the underlying base map. Note that the two **Qf** units both have the same color. Export the map as a **png** or **pdf** and email that file to me.

For a real geological map you would also populate the **DescriptionOfMapUnits** table with an editor and the additional tools within the **NCGMP09** toolbox.