ARC HYDRO GROUNDWATER TUTORIALS

Subsurface Analyst – Adding faults to cross sections

Arc Hydro Groundwater (AHGW) is a geodatabase design for representing groundwater datasets within ArcGIS. The data model helps to archive, display, and analyze multidimensional groundwater data, and includes several components to represent different types of datasets, including representations of aquifers and wells/boreholes, 3D hydrogeologic models, temporal information, and data from simulation models. The *Arc Hydro Groundwater Tools* help to import, edit, and manage groundwater data stored in an AHGW geodatabase. *Subsurface Analyst* is a subset of the AHGW Tools that is used to manage 2D and 3D hydrogeologic data, and create subsurface models including generation of borehole representations, cross sections, surfaces, and volumes.

Subsurface Analyst includes tools for creating 2D cross sections by adding data to a new XS2D data frame and "sketching" cross sections based on borehole stratigraphy, outcrops, faults, etc. In addition Subsurface Analyst supports the creation of 3D cross sections and volumes from a set of surfaces. The 3D features can be viewed in ArcScene or can be transformed to 2D so they can be displayed in ArcMap. The workflow and tools for creating 2D cross sections and 3D features are described in separate tutorial.

In this tutorial you will learn how to add faults to your cross sections.

1.1 Background

In a separate tutorial we built a cross section from borehole stratigraphy, outcrops, and terrain data. In this tutorial we will use the same cross section and add faults to it. Figure 1 shows the cross section location in map view and the vertical cross section representing the hydrogeologic units along the cross section.

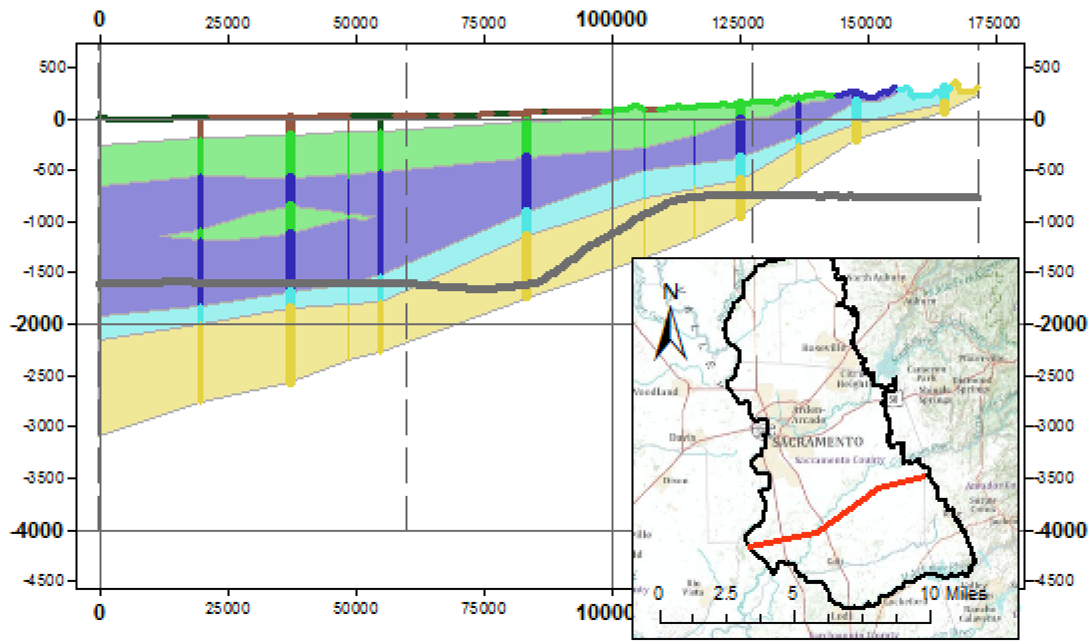


Figure 1 Cross section representing hydrogeologic units.

1.2 Outline

The objective of this tutorial is to introduce the basic workflow and tools for adding faults to 2D cross sections.

1. Get familiar with how faults are represented as point features with attributes describing the 3D setting of the fault.

2. Create a new XS2D Line feature class and transform faults onto a XS2D data frame.

1.3 Required Modules/Interfaces

You will need the following components enabled in order to complete this tutorial:

- Arc View license (or ArcEditor\ArcInfo)

- Arc Hydro Groundwater Tools

- AHGW Tutorial Files

The AHGW Tools require that you have a compatible ArcGIS service pack installed. You may wish to check the AHGW Tools documentation to find the appropriate service pack for your version of the tools. The tutorial files should be downloaded to your computer and saved on a local drive.

2 Getting Started

Before opening our map, let's ensure that the AHGW Tools are correctly configured.

1. If necessary, launch *ArcMap*.

2. If necessary, open the *ArcToolbox* window by clicking on the *ArcToolbox* icon .

3. Make sure the Arc Hydro Groundwater Toolboxes are loaded. If they are not, add the toolboxes by right-clicking anywhere in the *ArcToolbox* window and selecting the *Add Toolbox…* command. Browse to the top level of the *Catalog* and then browse down to the *Toolboxes|System Toolboxes* directory. Select the toolbox and select the *Open* button.

4. Expand the *Arc Hydro Groundwater Tools* item and then expand the *Subsurface Analyst* toolset to expose the tools we will be using in this tutorial.

We will also be using the *Arc Hydro Groundwater Toolbar*. The toolbar contains additional user interface components not available in the toolbox. If the toolbar is not visible, do the following:

5. Right-click on any visible toolbar and select the *Arc Hydro Groundwater Toolbar* item.

When using geoprocessing tools you can set the tools to overwrite outputs by default, and automatically add results to the map/scene. To set these options:

6. Select the *Tools | Options...* command and select the *Geoprocessing* tab.

7. Activate the option: "*Overwrite the outputs of geoprocessing operations*" as shown in Figure 2.

8. Enable the option to "*Add results of geoprocessing operations to the display*" as shown in Figure 2.

9. Select *OK* to exit the setup.

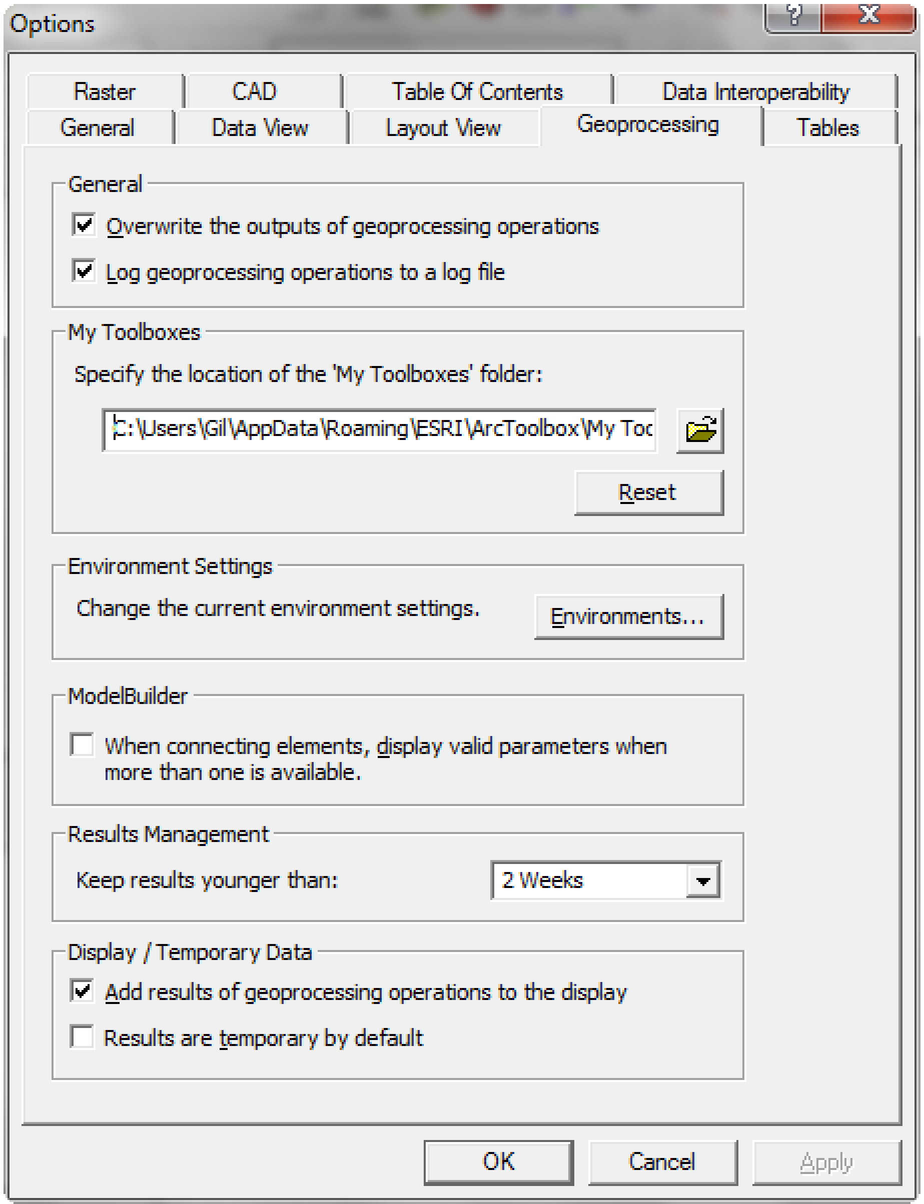


Figure 2 Setting geoprocessing tools to overwrite outputs by default, and to add results of geoproceesing tools to the display.

3 Opening the Map

We will begin by opening a map containing the cross section and background data for the project.

1. Select the *File| Open* command and browse to the location on your local drive where you have saved the AHGW tutorials. Browse to the *subsurface analyst\XS2D_Faults* folder and open the file entitled ***xs2d_faults.mxd***.

Once the file has loaded you will see a map of the Roseville, California area and a sketched cross section in a separate data frame.

4 Adding faults to your cross section

The map includes a Faults layer that represents faults as point features as shown in Figure 3.

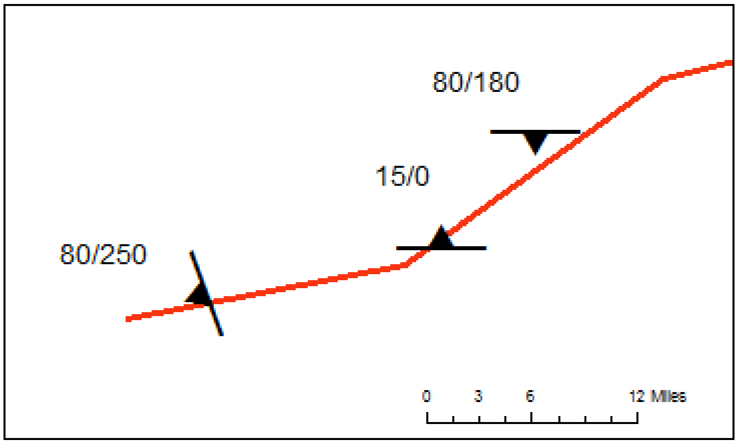
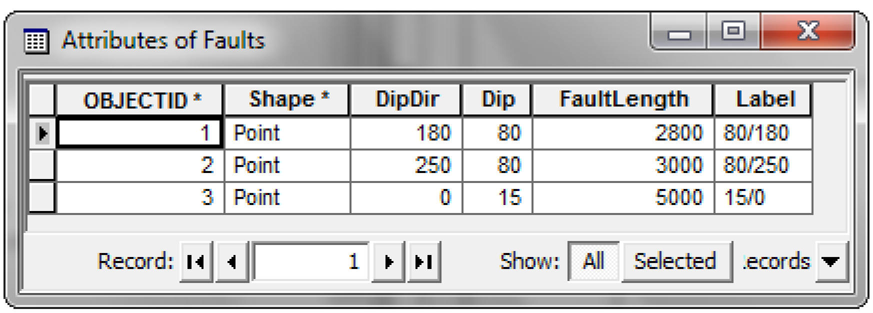


Figure 3 Faults represented as point features.

Additional attributes (see Figure 4) describing the dip direction, dip angle, and fault length describe the 3D orientation of the fault. The *DipDir* attribute describes the direction of the fault and is measured clockwise from the north (values range from 0 to 360). The *Dip* attribute represent the dip angle from a horizontal plane (values range from 0 to 90). The *FaultLength* attribute represents the length of the fault from the land surface. For example the first row represents a fault dipping to the south (DipDir = 180) and the angle of the dip is 80°.



Attributes of Faults

OBJECTID *	Shape *	DipDir	Dip	FaultLength	Label
1	Point	180	80	2800	80/180
2	Point	250	80	3000	80/250
3	Point	0	15	5000	15/0

Record: 1 Show: All Selected .ecords

Figure 4 Attributes of Fault features.

Before we add the faults to the cross section we will create a new XS2D Line feature class to hold the transformed faults. The faults will be projected onto the cross section surface and appear as line features on the cross section.

1. Ensure that the **Layers** data frame is active by right-clicking it and selecting *Activate*.

2. Select the ***Create XS2D Line Feature Class*** tool in *Arc Hydro Groundwater Tools / Subsurface Analyst / XS2D Editor*

3. Select the **SectionLine** layer for the *Input Section Line Features* parameter.

4. Select the **XS2D_Catalog** table for the *Input XS2D_Catalog Table* parameter.

5. For the *XS2DType* specify **Fault**.

6. Specify **Fault** for the *Feature Class Name Prefix.*

At this point your inputs should be similar to the ones shown in Figure 5.

7. Select *OK* to run the tool.

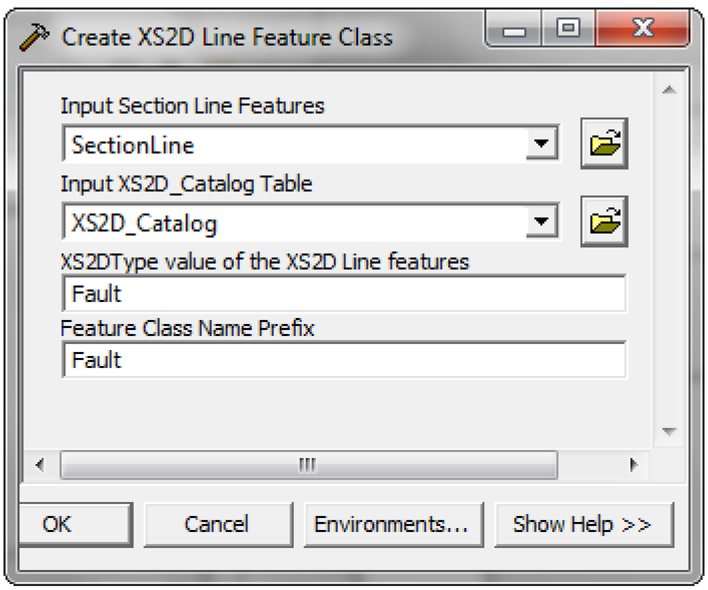


Figure 5 Settings for the Create XS2D Line Feature Class Tool*.*

The tool creates a new feature class named *Fault_6475*; also the XS2D_Catalog is updated to include a new record referring to the new feature class. Next, we will transform the fault features to create lines in the XS2D data frame.

To display faults on a cross section the 3D fault, defined by the dip, dip direction, and fault depth, is projected onto the cross section plane. Faults will then appear as lines on the cross section. We use the Transform Faults To XS2D Lines to transform the faults and create the line features.

8. Select the ***Transform Faults To XS2D Lines*** tool.

9. Specify the parameters as shown in Figure 6.

10. Select *OK* to run the tool.

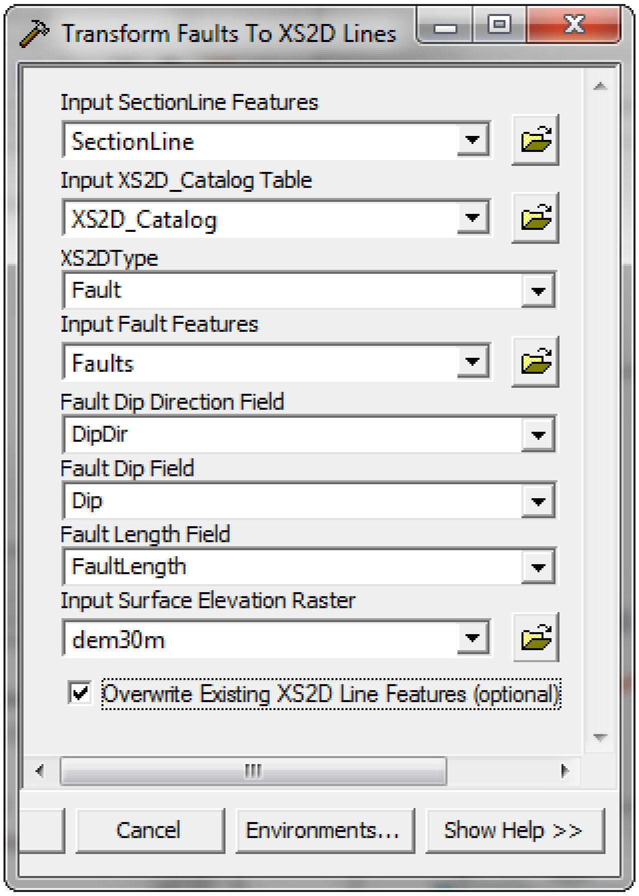


Figure 6 Settings for Transform Faults To XS2D Lines Tool.

The tool should create 3 new features in the Fault_6475 feature class.

11. Drag the *Fault_647*5 layer to the *Section A-A'* data frame. You should see the 3 faults on top of your cross section panels.

12. Symbolize the faults in the cross section.

At this point your cross section should be similar to the one shown in Figure 7.

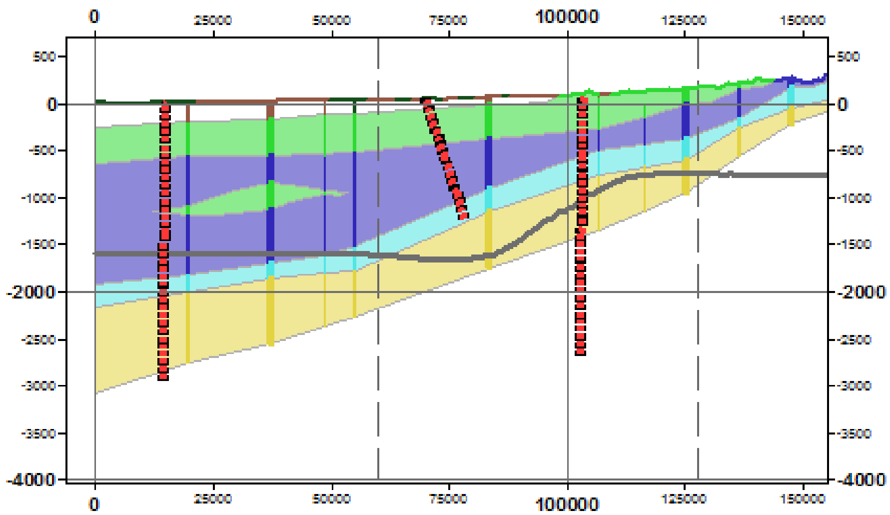


Figure 7 Lines representing the faults.

Notice that the cross section panels shown in Figure 7 do not really match the faults as they were sketched before adding the faults to the cross section. In practice, you can add the faults to the cross sections before sketching the cross section panels and use the fault lines on the cross section as guides for sketching cross section panels. Figure 8 shows an alternative set of cross section panels that better match the faults. Turn on layer ***XS2D_Panel_6475_with_faults*** to view the solution panels in your cross section data frame.

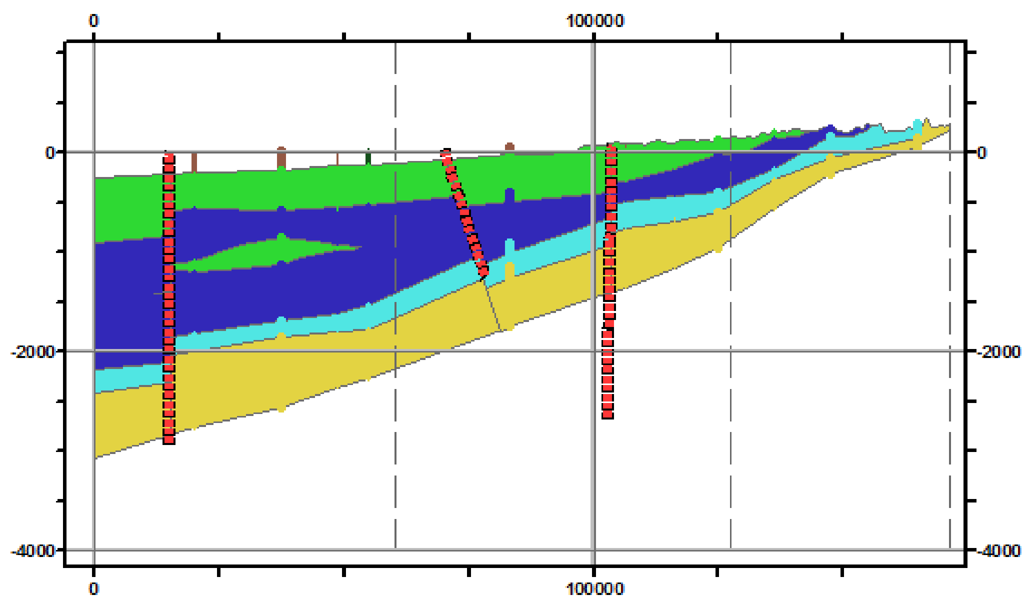


Figure 8 Cross section panels sketched based on faults.

5 Conclusion

This concludes the tutorial. Here are some of the key concepts in this tutorial:

- Faults can be represented by point features with attributes describing the direction, dip angle, and length.
- Faults can be added to cross sections as line features by transforming fault features and projecting them into a XS2D data frame.