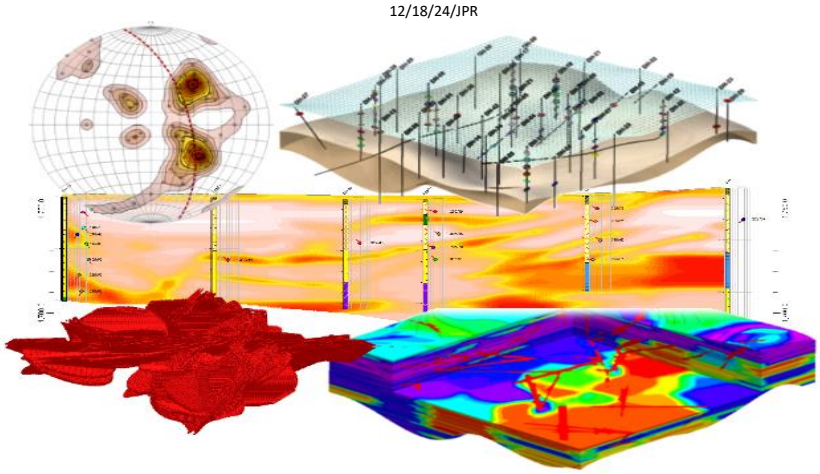
# Displaying & Modeling Fractures Based on Downhole Data

12/18/24/JPR



**Contents**



## Adding Fractures to the Borehole Database

- Select the *Borehole Manager* tab from the main *RockWorks* menu, highlight the appropriate *Borehole*, and click on the *Fractures* tab *(*Figure 1*)*.

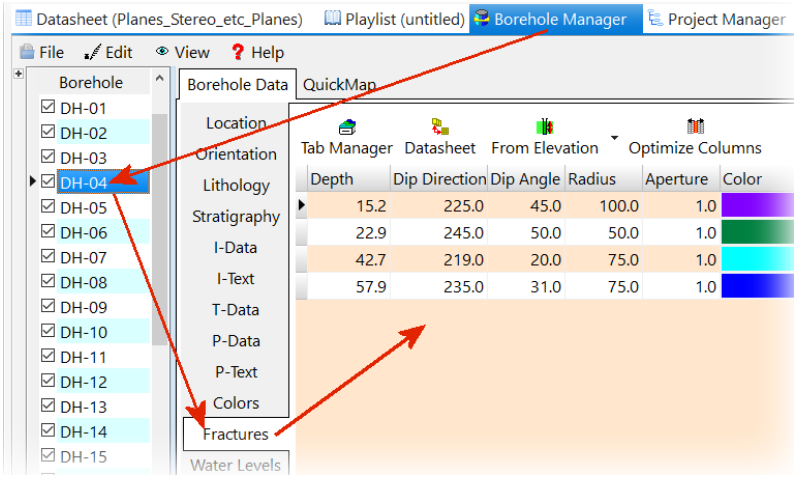



*Figure 1*

- For each fracture observed within a borehole, enter the;
  - **Depth**: Type in the measured depth for fracture that you wish to record.
  - **Dip Direction**: Enter the dip bearing in azimuth degrees (from 0 to 360) of the fracture.
  - **Dip Angle**: Enter the angle in degrees from horizontal (0 = horizontal, 90 = straight down).
  - **Radius**: Enter the fracture radius in your data units (feet, meters). This will determine the size of the fracture disk as displayed on 3D striplogs, and will affect any fracture modeling that you may perform.
  - **Aperture**: Enter the fracture thickness. When displayed in 3D, this will affect the thickness of the fracture disk as it's displayed with the logs.
  - **Color**: Double-click in this cell and choose a color for the fracture "disk" that will be displayed in the logs and log sections.

**Plotting Fractures Within 2D Striplogs**

- Select the *Borehole Operations / Striplogs / 2D Striplog* program from the main *RockWorks* menu (Figure 2).

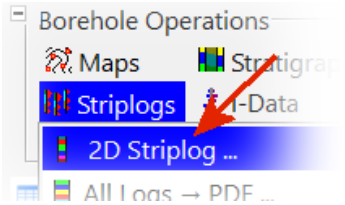



*Figure 2*

- Select *2D Log Design* tab at the top of the *Single 2D Striplog* menu (Figure 3), adjust the *Fractures* settings based on your preferences, and click on the Continue button.

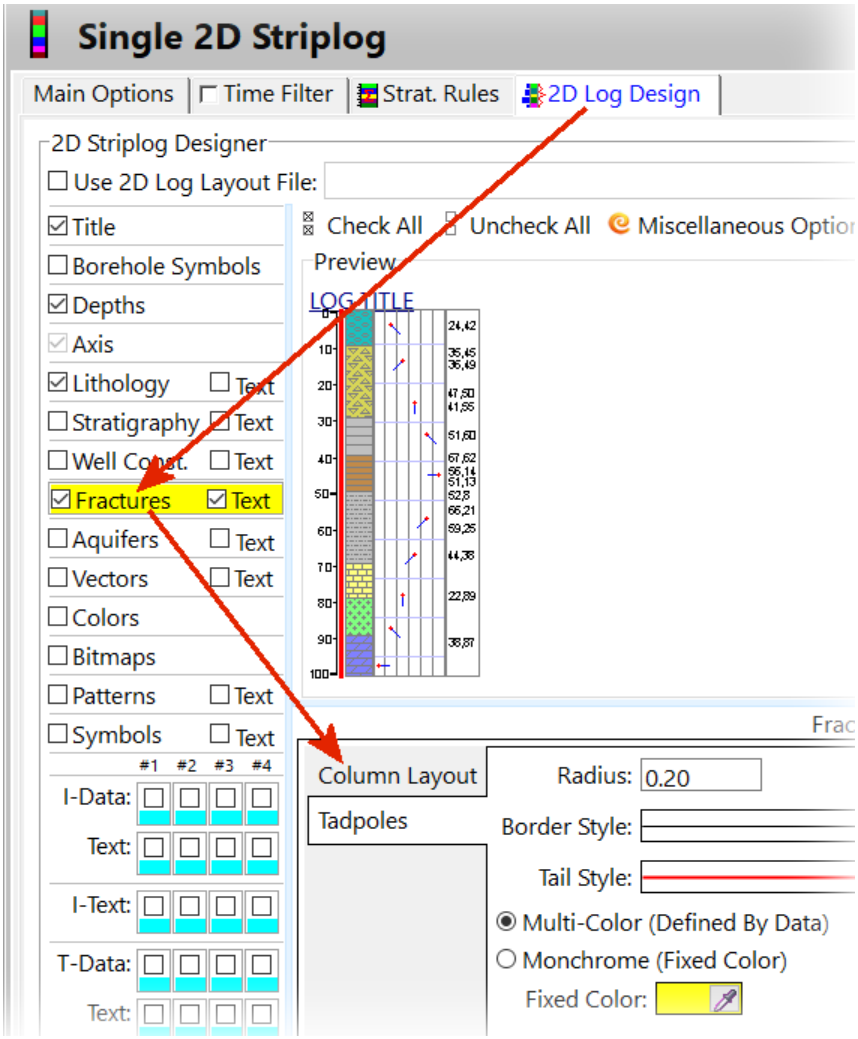



*Figure 3*

- A striplog for the selected borehole will now appear (Figure 4). To adjust the appearance of this log, click on the Main Options tab, make the appropriate changes, and click on Continue button again. Repeat this process, if necessary, until you are satisfied with the appearance of the striplog.

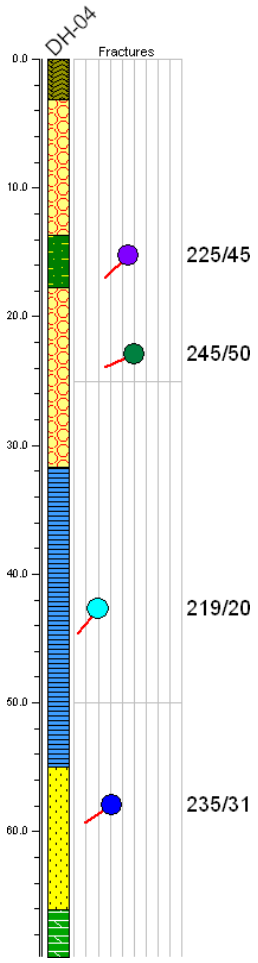



*Figure 4*

- Notice that there's an option within the *2D Log Design* menu titled "*Save Layout*" (Figure 5). This provides a means for using this particular striplog layout to eliminate the hassle of re-creating it within other projects.

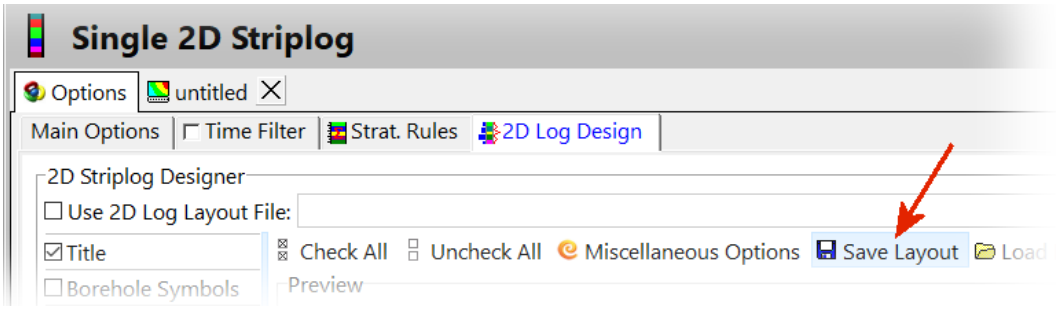



*Figure 5*

- The last-used log layout will be used when creating other diagrams that display 2D striplogs such as the sections and profiles (Figure 6).

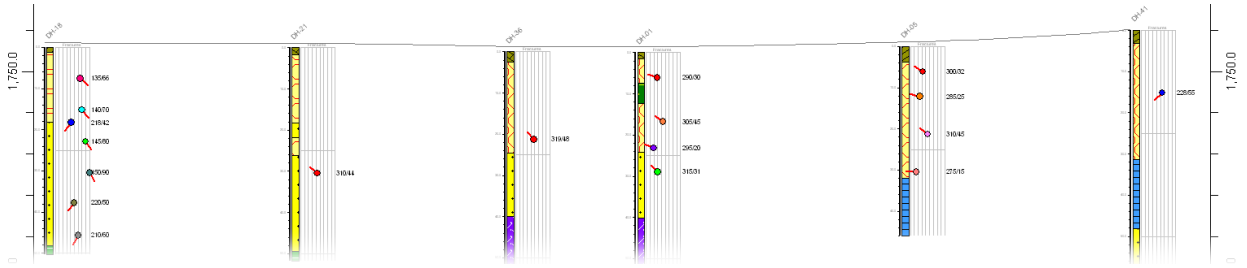


*Figure 6*

**Plotting Fractures Within 3D Striplogs**

- Select the *Borehole Operations / Striplogs / 3D Striplog* program (Figure 7).

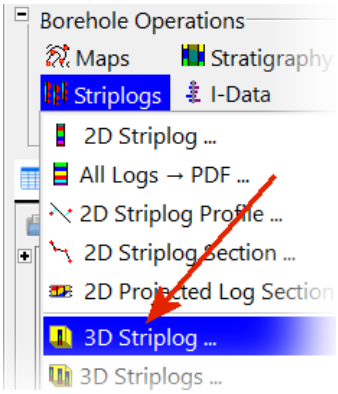



*Figure 7*

- Select the *3D Log Design* tab, click on the *Fractures* tab, and adjust the *Fracture Options* (Figure 8) to suit your needs. Note that all of the menu items are explained in detail by clicking of the red icons with a white question mark in the center.

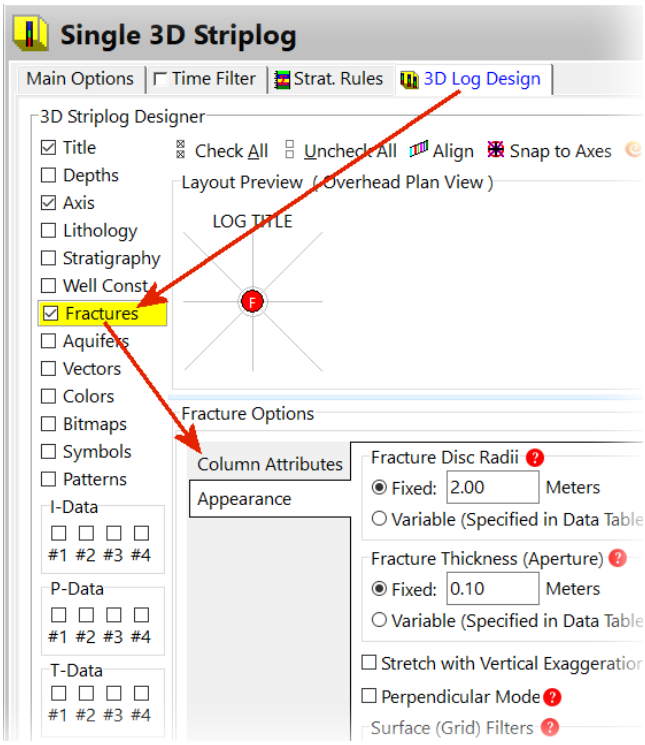



*Figure 8*

- As with other RockWorks programs, such as the 2D Striplog program, some iterative experimentation may be required to obtain the optimal striplog (Figure 9).

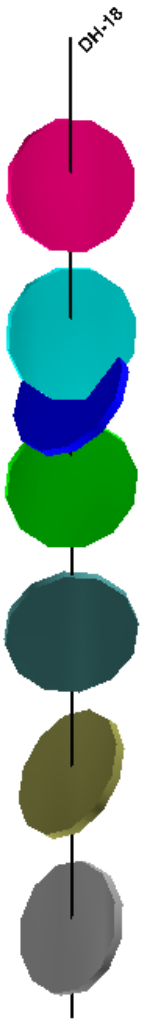



*Figure 9*

- The last-used log layout will be used when creating other diagrams that display 3D striplogs such as the stratigraphic modeling (Figure 10).

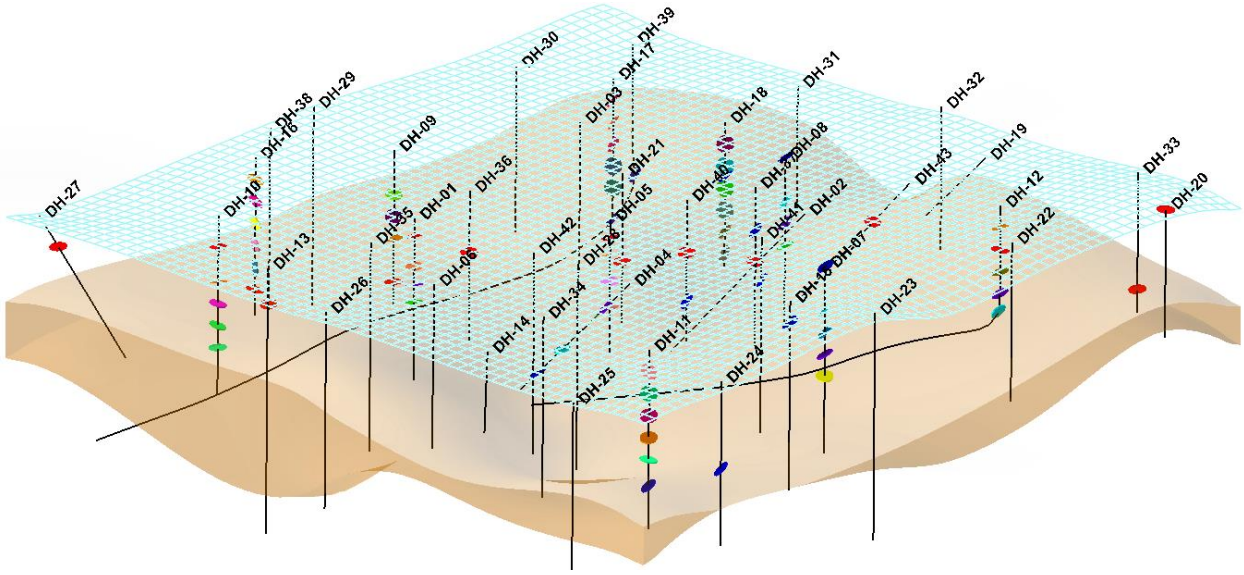



*Figure 10*

**Creating Stereonets Based on Borehole Data**

- Select the *Borehole Operations / Fractures / Stereonet* program (Figure 11).

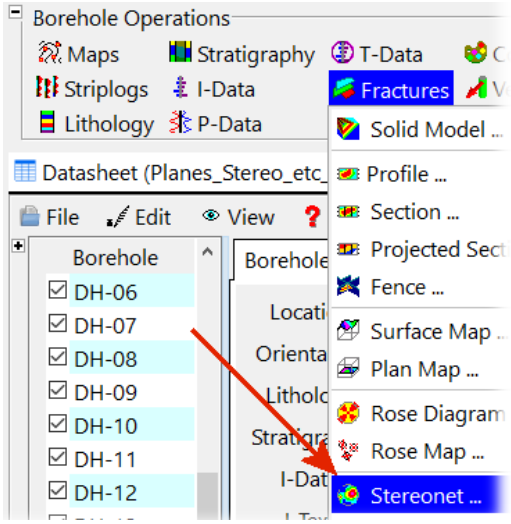



*Figure 11*

- Configure the *Borehole Fractures -> Stereonet* menu (Figure 12) for the type of stereonet that you want. Please note that extensive documentation is displayed along the right side of the menu.

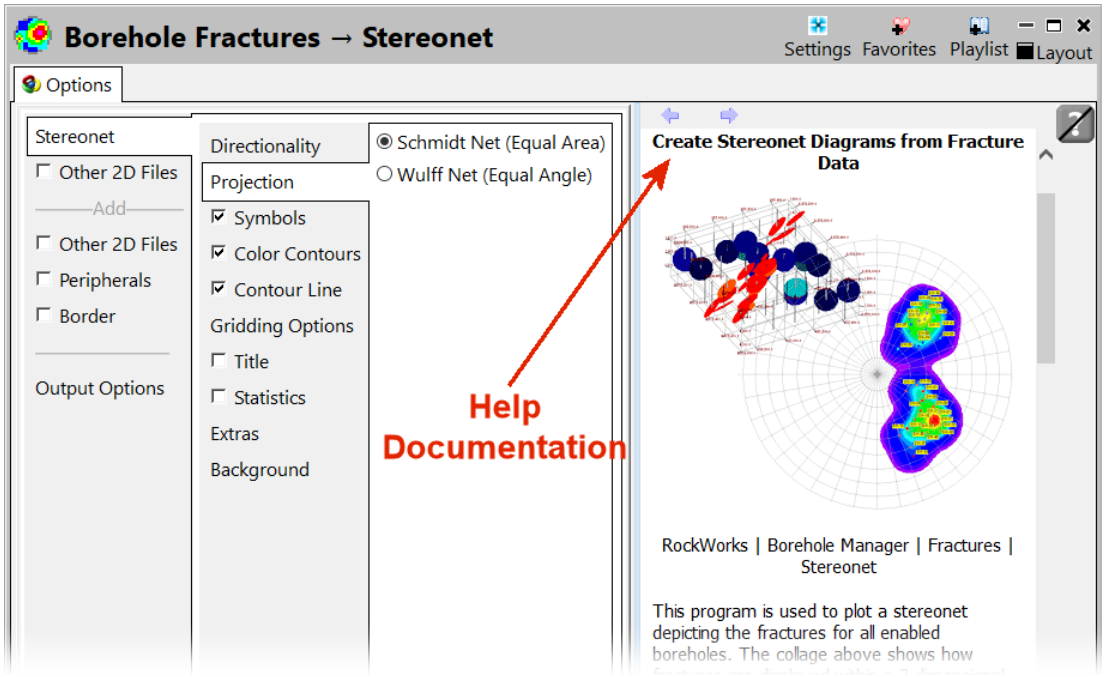



*Figure 12*

- Click the *Continue* button and a stereonet (Figure 13), depicting all of the fractures within the enabled boreholes will be displayed. In this example, the program was configured to plot a *Best-Fit Great Circle* as a thick red dashed polyline.

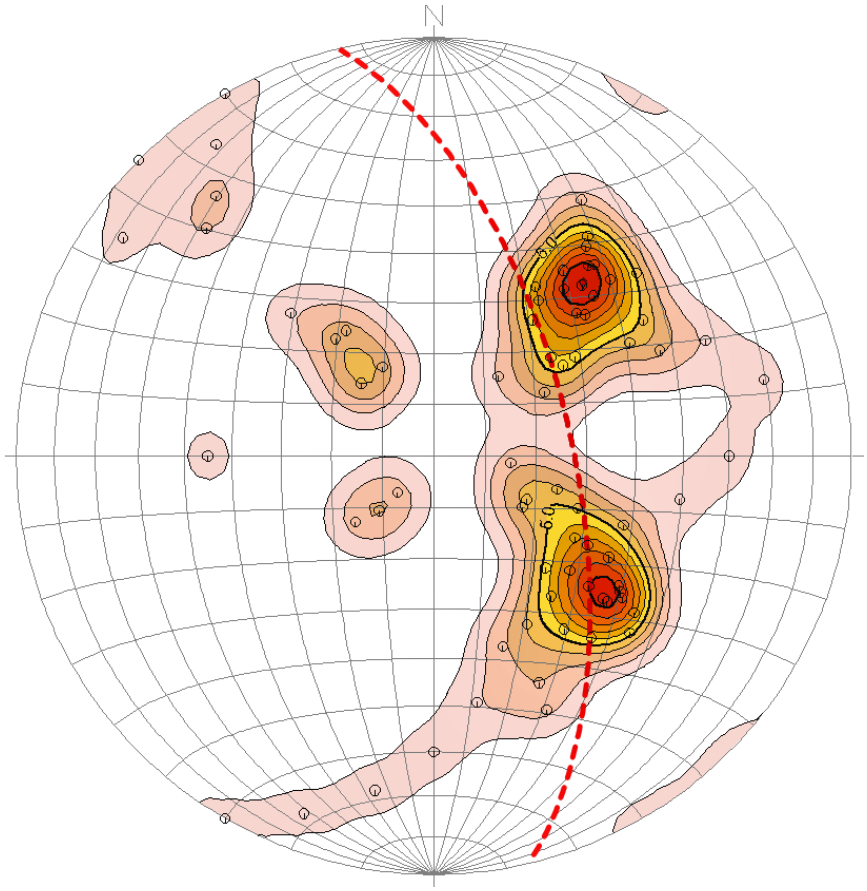



*Figure 13*

**Creating Stereonet Maps Based on Borehole Data**

- Select the Borehole Operations / Fractures / Stereonet Map program (Figure 14).

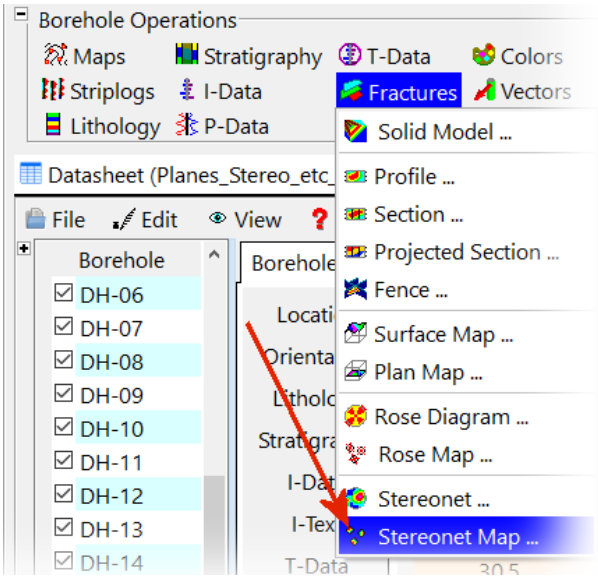



*Figure 14*

- To produce a meaningful map of stereonets depicting the orientations of fractures within each borehole, you might want to eliminate all but the most salient features. In this example (Figure 15), we're showing all of the fractures as Great Circles and a Best-Fit Great Circle as a thick, dashed red polyline.

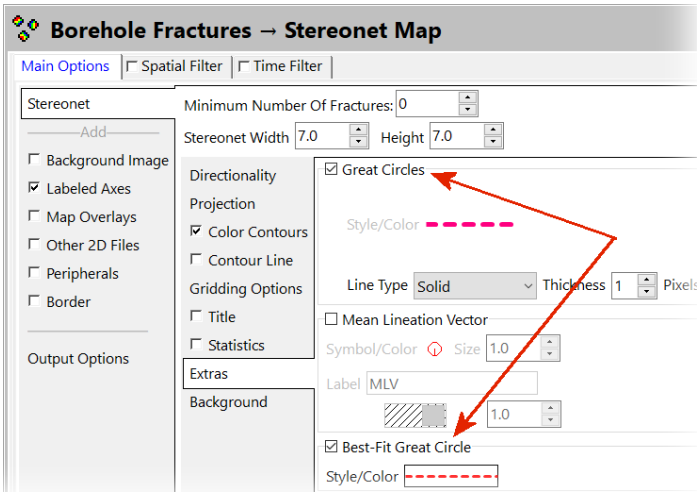



*Figure 15*

- Click the *Continue* button and a stereonet map (Figure 16) will be displayed as a new tab within the *Borehole Fractures -> Stereonet Map* menu.

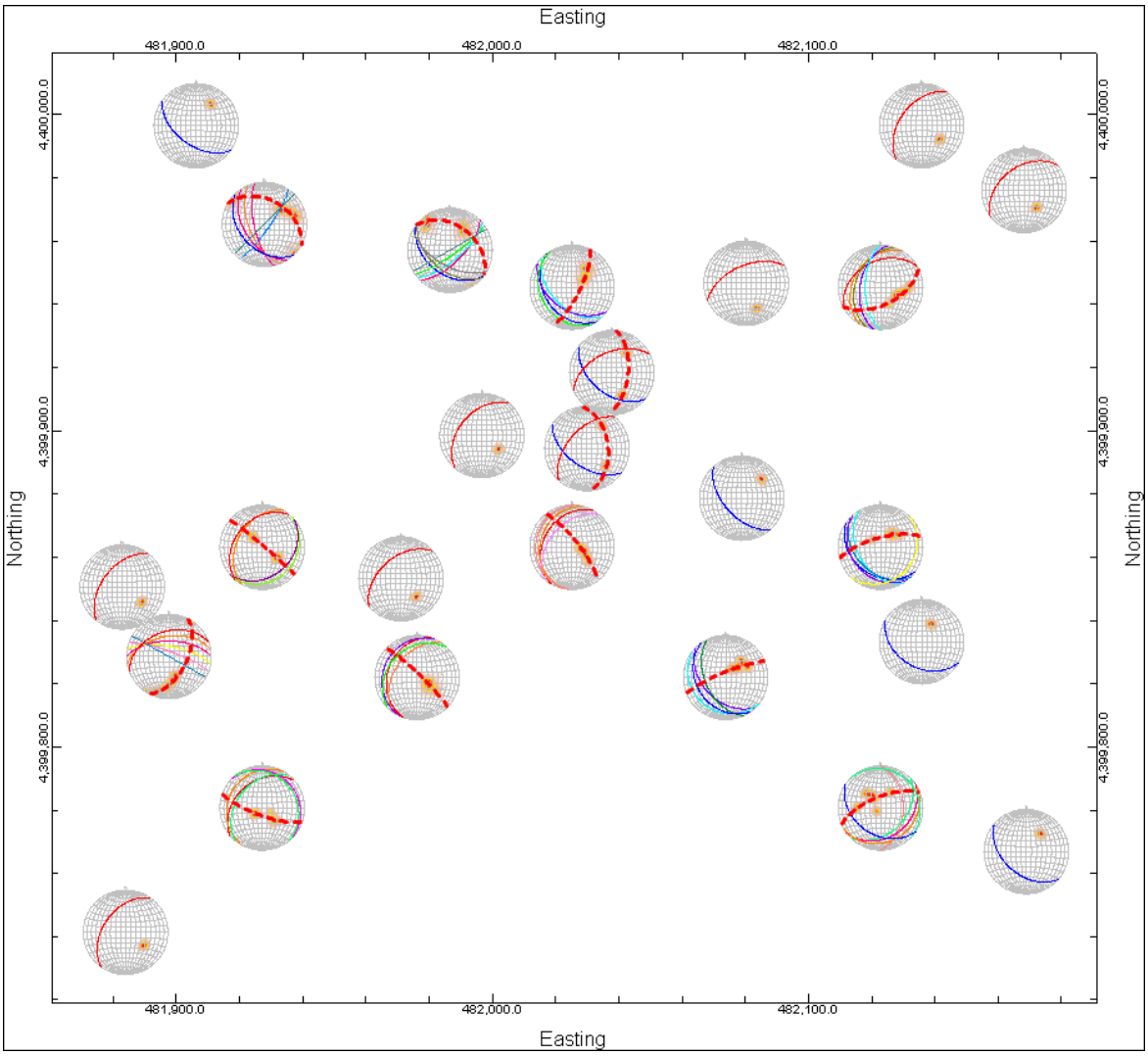



*Figure 16*

## Creating Fracture Models

- Select the *Borehole Operations / Fractures / Solid Model* program (Figure 17).

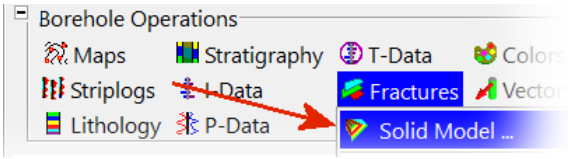



*Figure 17*

- Notice the *Output Type* option within the *Create New Model / Fracture Options* tab (Figure 18). These six "flavors" define the different types of models that can be created with this program. Select the type of model that you want and click on the *Continue* button.

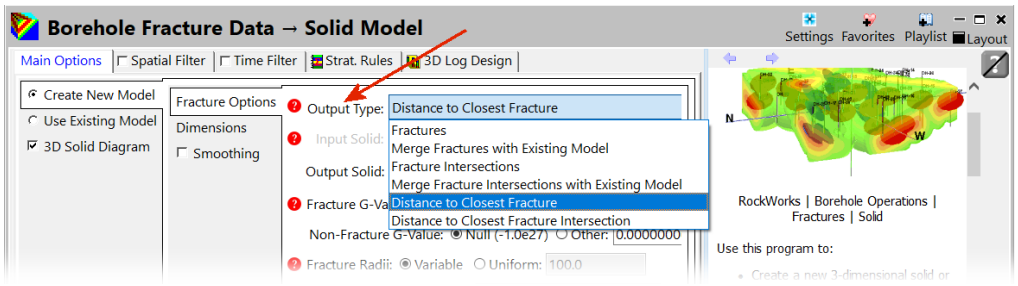



*Figure 18*

- As shown within Figure 19, the *Fractures* (1), *Fracture Intersections* (2), *Distance to Closest Fracture* (3), and *Distance to Closest Fracture Intersection* (4) models may be used for a variety of purposes such as predicting karstification associated with fractured carbonates.

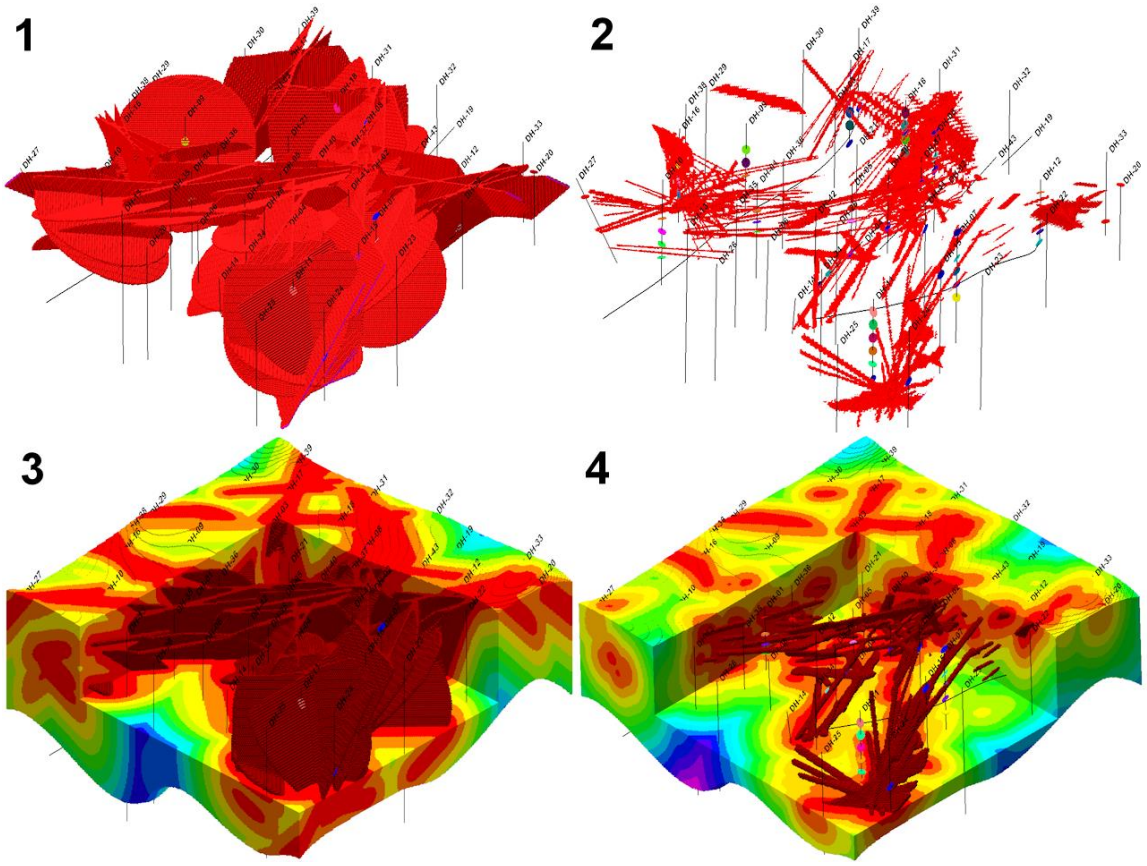



*Figure 19*

- The *Merge Fractures with Existing Model* and *Merge Fracture Intersections with Existing Model* options can be used to add hydraulic conduits or hydraulic barriers to existing hydraulic conductivity and geothermal models. As shown within Figure 20, Model #1 depicts a distance-to-closest fracture model, Model #2 depicts a hydraulic conductivity model, and Model #3 depicts the hydraulic conductivity model after applying the *Merge Fracture Intersections* program. Notice how the fractures are providing flow pathways. Keep in mind that the opposite effect can be applied to fractures that may act as hydraulic barriers (e.g., clay-filled gouge zones).

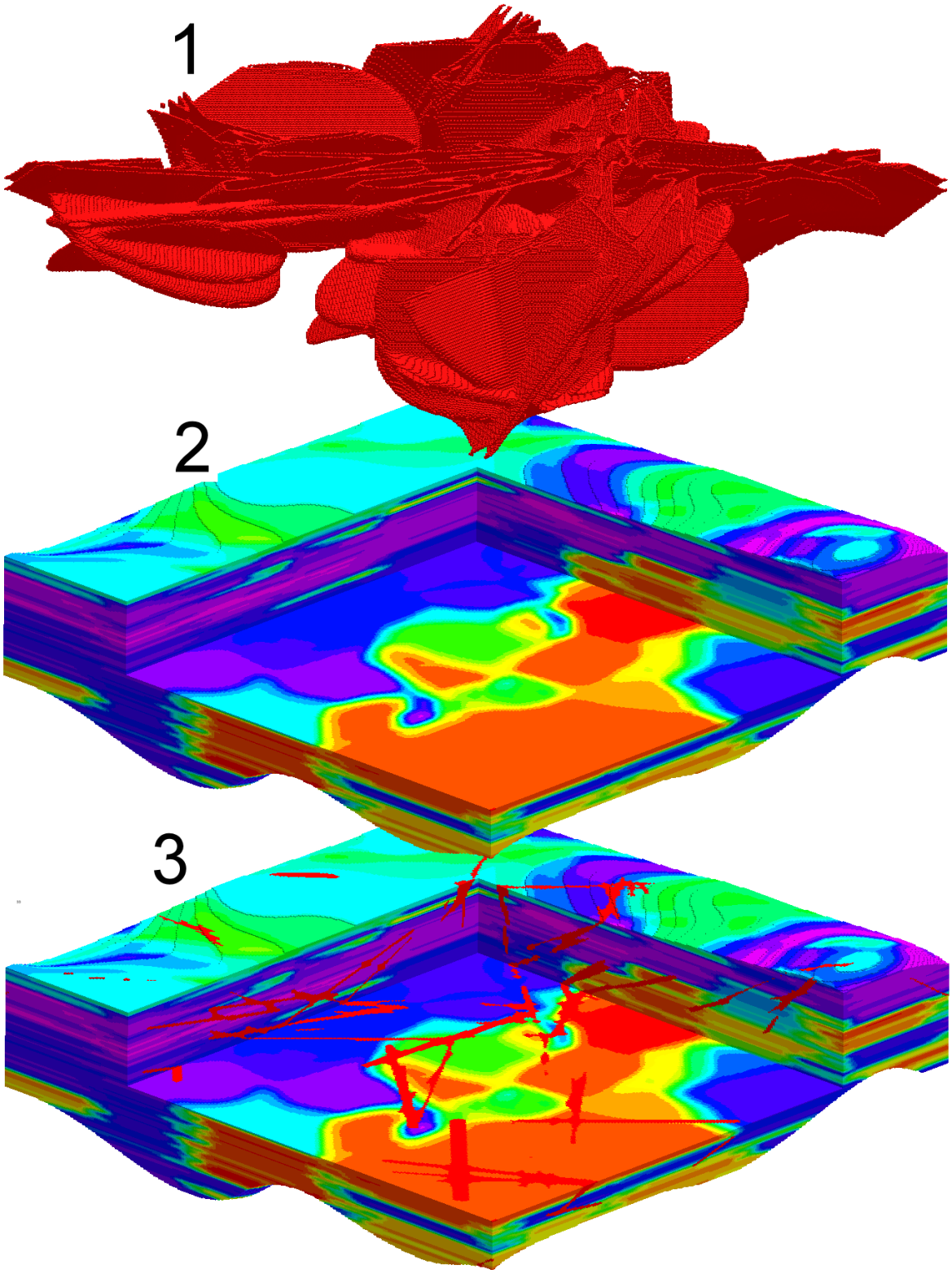



*Figure 20*

- A more detailed understanding of the relationships between the borehole fractures and potential flowpaths can be obtained by using the *ModOps / Solid / Section* program to vertically slice through the modified hydraulic conductivity model (Figure 21).

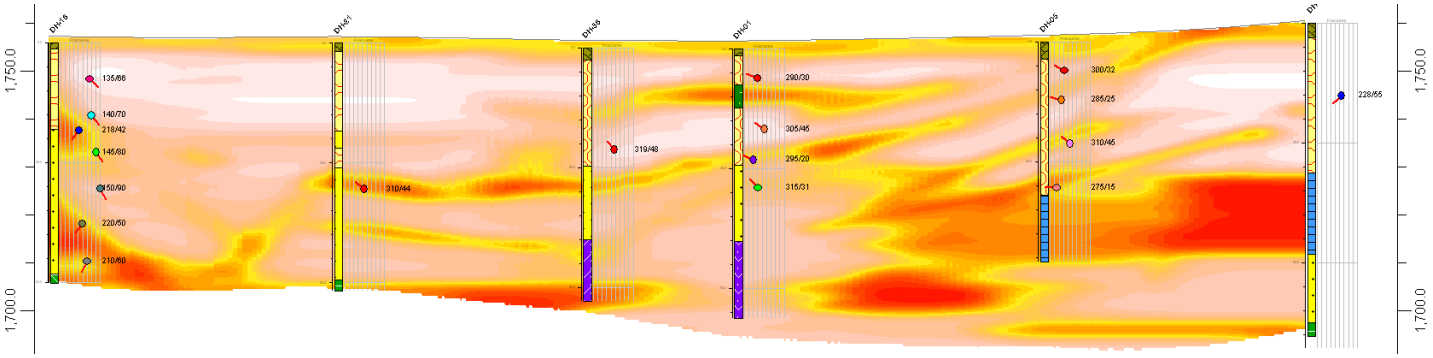



*Figure 21*